# BOOK OF ABSTRACTS

# PECS 2015 CONFERENCE

## Social-ecological dynamics in the Anthropocene

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# KEYNOTE ABSTRACTS

*Listed alphabetically – by Surname*

**Talk Title** **A CULTURAL ECOLOGY OF THE ANTHROPOCENE: UNDERSTANDING SOCIAL-ECOLOGICAL DYNAMICS IN THE AMAZON DELTA**
Presenter Prof Eduardo Brondizio
Organisation Anthropological Center for Training and Research on Global Environmental Change (ACT)
Country United States
Abstract Taking the Amazon delta region as a reference, this presentation reflects on the research challenges encapsulated in the PECS 2015 conference theme: Understanding social-ecological dynamics in the Anthropocene. Doing field research for over 25 years in a region undergoing accelerated changes – social and environmental – has forced us to confront the strengthens and limitations of our concepts, analytical frameworks, and methodologies; and, of course, reflect on the relevance of our research questions. I will reflect on these issues from two perspectives. First, I will briefly overview the evolution of human-environment research from the early days of Cultural Ecology in the 1950s to today's Social-Ecological Systems frameworks. The Amazon has been a laboratory informing the evolution of these approaches. I will explore some of the parallels between the analytical challenges we face today to that of scholars studying human-environment interaction at the onset of the so-called 'great acceleration' following WWII. Second, the above discussion will be illustrated by 'taking the audience to the field'. I will show research examples illustrating the evolution conceptual frameworks and methodological approaches as research questions have changed from localized community-level studies to their interaction with global markets and urban areas to the delta region as a whole. I conclude by discussing current efforts (and difficulties) to understand these social-ecological dynamics in a region increasingly influenced by large-scale infrastructure projects, urbanization, and climate change.

**Talk Title** **SCENARIOS: BALANCING THE COMPUTABLE AND THE NONCOMPUTABLE**
Presenter Steve Carpenter
Organisation University of Wisconsin-Madison
Country United States
Abstract Decisions about the future must take account of the complexity, uncertainty, and rapid pace of change of social-ecological systems. To think about the future, models are used in many forms: images, stories, equations, computer programs and so forth. Models of the future necessarily employ untestable assumptions of what we can control and how complex system dynamics will evolve. There is a tendency to turn to formal models (such as equations or computer programs) to analyze uncertainty and guide decisions. While formal models of social-ecological systems have led to important research insights, they are unreliable guides to policy decisions. When model predictions are wrong, it is often because of what they do not include. These omissions pose serious problems for decision-making processes that rely on models. Perhaps the omissions can be addressed by increasing the scope of information used to assess the future. A wider view can develop through input from a broad spectrum of diverse stakeholders. Settings for associative thinking, such as art-science collaborations, can evoke new ideas and thereby generate fresh approaches. Scenario exercises can provide a framework for rapid prototyping of new ideas and safe experiments to explore the future. Nonetheless, it is quite challenging to maintain the open, generative conversations that lead to broad, inventive thinking about social-ecological futures. Experiences in the Yahara Watershed project (http://Yahara2070.org) illustrate these points.

**Talk Title** **AGROFORESTRY SOLUTIONS FOR RECONCILING RESOURCE USE AND BIODIVERSITY CONSERVATION IN AFRICA**
Presenter Dr Cheikh Mbow
Organisation World Agroforestry Centre (ICRAF)
Country Kenya
Abstract The recognition of agroforestry and biodiversity conservation into productive landscapes has become an imperative subject of recent land sharing scenario. Agroforestry practice can contribute to biodiversity conservation and examples of actionable practices will be presented based on the multiple roles of agroforestry for biodiversity conservation in African context. We will assess to what extent agroforestry contributes to the achievement of biodiversity related to global policies and targets such as Aichi Target and CBD within the African context? The study suggest to explore agroforestry benefits for the dual needs for ecosystem services and biodiversity conservation. Many have seen agroforestry as an option for land sharing but this assumption has not been questioned on the basis of a systematic review of agreement and evidences from the literature. Tentatively the following research questions will be addressed:
- What are the multiple benefits of agroforestry in Africa, including emerging issues such as value for biodiversity and ecosystem services?
- How can ecosystem service is delivered through agroforestry systems and how this can be optimized?
- How can agroforestry recommendations be adjusted to harmonize with emerging conservation requirements such as land sharing and functional biodiversity?

- What and where are the agroforestry land use systems that represent high performing practices that help achieve longer-term conservation goals?
- Which agroforestry systems support healthy, ecologically functional landscapes?

We will conclude by identifying barriers and gaps for resource provision and conservation and what are the lessons of agroforestry interventions in Africa.

**Talk Title** **SOCIAL-ECOLOGICAL SYSTEMS IN THE ANTHROPOCENE: NEW DYNAMICS, CHALLENGES AND OPPORTUNITIES**

Presenter Prof Garry Peterson
Organisation Stockholm Resilience Center, Stockholm University
Country Sweden

Abstract People are embedded parts of the biosphere and shape it, from local to global scales, from the past to the future. At the same time people are fundamentally dependent on the capacity of the Biosphere to sustain human development. Humanity has emerged as a major force in the operation of the Biosphere. As an effect of the tremendous increase in speed, connectivity, spread, and scale, everyone is now in everyone else's backyard and every corner of the Biosphere is shaped by us humans in one way or another. Such intertwined social-ecological systems are here approached as complex adaptive systems with resilience thinking as a lens to understand their dynamics across levels and scales. A biosphere-based sustainability science that sees people and nature as interdependent social-ecological systems provides exciting opportunities for societal development in tune with the biosphere. This talk will discuss challenges and opportunities of stewardship of the biosphere for human wellbeing and sustainability and the role of PECS research in this context.

**Talk Title** **SOCIAL-ECOLOGICAL SYSTEMS APPROACHES FOR DEVELOPMENT IN THE ANTHROPOCENE: EXPERIENCES FROM SOUTH AFRICA**

Presenter Belinda Reyers
Organisation Stockholm Resilience Centre, Stockholm University
Country Sweden

Abstract This presentation will explore the conference theme of “Understanding social-ecological dynamics in the Anthropocene” and the application of that understanding in development choices from local to global scales. The challenge of meeting development needs without undermining planetary life support systems, in an increasingly connected and turbulent world, requires new paradigms and approaches for development. Social-ecological systems thinking and approaches offer exciting opportunities to shift development paradigms and investments towards a new global vision for sustainable development that is able to track and shape change across sectors and scales. The presentation will explore a set of use cases in South Africa that have adopted a social-ecological systems lens and actionable tools in partnership with public and private sectors to address a series of complex challenges. Based on these experiences from disaster management, urban planning, water security and national development planning, I will reflect on some of the impacts, lessons learned and challenges ahead, as well as explore how we might upscale these experiences to work towards a universal and integrated post-2015 development agenda.

**Talk Title** **POSTCARDS FROM THE EDGE: TRANSITIONING FROM BLUE SKY TO COAL FACE…**

Presenter Dr Debra Roberts
Organisation Planning and Climate Protection Department of eThekwini Municipality

Abstract There is a growing realization that the world has changed and that it will continue to change, driven by forces such as globalization, urbanization and climate change. In this world of increasing uncertainty, scientists and practitioners alike are being drawn into the uncomfortable and politically charged space between research and policy making. This is a personal socio-ecological story of a biologist who became a local government official to try and better negotiate this space. In telling the story there is the opportunity to reflect on some of the lessons learned in the transition from blue sky to coal face.

# SESSION ABSTRACTS

*Listed alphabetically – by Surname*

**Talk Title** **FINDING STRUCTURE IN DIVERSITY: FUNCTIONAL TRAITS AND THEIR USE IN STUDIES OF SOCIAL-ECOLOGICAL SYSTEMS**
Theme Theme 3
Presenter Dr Erik Andersson
Country Sweden
Abstract Co-organizers: A/Prof Erik Andersson, Stockholm Resilience Centre, and A/Prof Timon McPhearson, The New School
Background - The role of biodiversity in the social-ecological production and valuation of ecosystem services remains unclear, despite decades of studies. This session will explore the utility of a functional traits approach as a way to draw mechanistic links of understanding between biodiversity and ecosystem services. It takes a social-ecological systems approach to explore not only the ecological meaning of patterns of functional traits, but also how human preferences and management actions are informed by and drive these patterns. We are interested in how to better accommodate biodiversity in social-ecological studies. The session will present different, interdisciplinary methodological approaches that includes elements from both biological and social sciences, and produces both quantitative and qualitative data is used, in order to elucidate and create a robust picture of what is going on in a landscapes (biologically, in terms of functional trait profiles across different land cover/land uses) and why (socially, in terms of what kind of management actions people are taking to produce exhibited trait profiles, and their motivations and preferences behind these actions). This session aims to explore some of these challenges, with the goal of addressing the PECS Conference Themes of "Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing" and "Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems" as well as "How governance and institutions affect social-ecological systems, including capacity for learning and transformations."
Session Objectives
- Explore different approaches and potential uses of the functional traits framework;
- Explore how the traits lens can help bridge these different methods and approaches;
- Identify future research directions for assessing human-nature relationships, ecological resilience, valuation, and governance and management of ecosystem services;
- Discuss traits as a vehicle for regional comparisons;
- Discuss the linking of functional traits to the broader discourse and research of how biodiversity and ecosystem services to IPBES assessment and development of the Global Biodiversity Monitoring project of Future Earth

Proposed Approach - In this topic-contributed session (60 minutes), we will invite four keynote presenters to each present a different angle and potential use of the functional traits approach (5 minutes each) and leave two empty slots for additional contributions. Following presentations, we will open up for short reflections from invited discussant and then encourage a 20-30 minute panel discussion between the audience, keynote presenters, and discussants about the potential and limitations in applying the traits framework for addressing a variety of social-ecological questions across different systems. These ideas will be documented in preparation for a follow-up article and research proposal, and serve as potential groundwork for future discussions within PECS.
Panel Speakers - Julie Goodness: Ecosystem services and human preferences
Erik Andersson: Ecological resilience and green infrastructure
Timon McPhearson: Urban species richness, traits, and resilience
Pippin Anderson: Comparative trait studies
Potential discussants:
Graeme Cummings
Jens Kattge
(Max Planck - TRY Database: https://www.bgc-jena.mpg.de/functionalbiogeography/index.php/People/JensKattge)Bonnie Keeler (Natural Capital Project)Katrin Boehning-Gaese (http://www.bik-f.de/root/index.php?page_id=256)Henrique Pereira (http://webpages.fc.ul.pt/~hmlpereira/)

**Talk Title** **DYNAMIC URBAN REGIONS**
Theme Thresholds, traps and transformations in social-ecological systems.
Presenter Prof Xuemei Bai
Country Australia
Abstract Rapid worldwide urbanization is one of the most transformative global phenomena of our generation, with far-reaching economic, political and environmental implications. Urbanization is a global trend that varies across time and space; several regions are currently experiencing relatively more rapid change, such as Yangtze River Delta in China, Amazon region in Brazil, Mekong River region, Sub-Saharan Africa and the Delhi-Mumbai corridor in India. Some other urban regions are going through rapid transition and transformation where cities are shrinking rather than growing. These highly dynamic urban

regions represent very different processes under different socio-economic conditions, e.g., with some regions being affluent and rapidly growing (Eastern Asia) and others less affluent and rapidly growing (parts of Africa), often confronting highly deficient infrastructure. However, all of these regions are facing multiple and intertwined drivers and are thus in high need for knowledge to guide practices, and with many opportunities for intervention to realize transition and transformation towards alternative future trajectories. In these regions, urbanization is closely linked to almost all of the eight grand challenges identified by Future Earth, and therefore can be used as an entry point to address these challenges. This workshop will outline the framework for a multi-national interdisciplinary place-based comparative research initiative building upon on-going, but independent research in several highly dynamic regions, aiming to understand: a) the drivers of urban growth; b) the role of actors/agencies /policies/external processes (such as foreign investment) in urban growth; c) the interlinkages (tradeoffs and synergies) between different processes and between urban and rural areas; d) the impacts (social, economic, environmental and human wellbeing) of rapid urbanization and associated processes, e) the opportunities for improved human well-being and sustainable use of resources, and f) leverage points for interventions and actionable options towards sustainability transitions. Specifically, the workshop aims to flesh out detailed conceptual and methodological design of one to several proposals aiming at building a global comparative research program linked to several existing core projects (like PECS) and part of the new Urban Knowledge Platform within Future Earth. The research program will specifically analyze how urbanization is influencing the food-water-environment-human wellbeing nexus; to identify the locally embedded leverage points and actionable options for a more sustainable urbanization; and how different cultural, institutional and governance arrangements, stakeholder visions and aspirations influence the choices across several contrasting regional contexts. Such a research endeavor will require large amounts of information on the multi-dimensional aspects of urbanization including remote sensing, historical, socioeconomic, institutional and environmental data, and require multiple partners within and beyond the selected regions, including academic institutions, decision makers and practitioners. The aim is to build a research program that will be co-designed and knowledge co-produced with the stakeholders within the region, solution oriented and with strong policy linkages.

**Talk Title** **BALANCING PLACE-BASED AND GLOBAL PERSPECTIVES: CHALLENGES AND OPPORTUNITIES**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Dr Patricia Balvanera
Country Mexico
Abstract Addressing the challenges posed by the search for more sustainable social-ecological systems requires understanding the role of global and that of context dependent drivers and system dynamics. International collaboration among sites where place-based research is taking place such as that undertaken by PECS can provide answers to some of these questions. Yet, a recent survey of projects within the PECS network highlighted important challenges to such collaboration. The aim of this workshop is to further inquire on the challenges and opportunities for balancing place-based and global perspectives in sustainability research.
We will briefly introduce some of the advantages of international collaborations and the links between place based results in contrasting contexts emerging from networks such as PECS. Then, in the first part of the workshop will focus on the challenges faced in the context of international collaborations such as those fostered by PECS. Examples of previously identified challenges include power relations among researchers, imposition of epistemologies or conceptual frameworks and north-south imbalances in leadership and funding availability. In the second part of the workshop will focus identify the most relevant challenges and suggest strategies to navigate them.
Finally, we will discuss results from this exercise and explore future steps needed towards generating a collective paper with on this topic.

**Talk Title** **WHAT DOES IT MEAN TO BE A PLACE-BASED SOCIAL-ECOLOGICAL SYSTEMS RESEARCHER? REFLECTIONS ON TOOLS, COMPETENCIES AND POSITIONALITY**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Ms Jessica Cockburn
Country South Africa
Abstract Scholars in the early stages of social-ecological systems (SES) research often feel adrift in an interdisciplinary world, without solid foundations in a single discipline, or a well-defined scholarly community. In Montpellier last year, students and early-career researchers from around the world met and engaged with these issues in a series of sessions at 'Resilience 2014'. Through this process, as well as ongoing discussions within regional student networks, the following questions have arisen: 1) What is our identity as SES researchers?; 2) What are the challenges we experience in applying suitable tools and approaches for place-based, transdisciplinary research?; and 3) How do we build a career as SES researchers? To address these questions and foster a sense of community among emerging researchers, we would like to continue these conversations at a special session at PECS 2015. This conference represents a perfect opportunity to engage on core issues of what it means to be a social-ecological researcher in the Anthropocene. We propose an interactive two-part session during which we will reflect on the tools and approaches available, the competencies needed in this research arena, and our role as scientists. PART I: Game of Theories – A Contest of Beliefs (30 min)Who are we as researchers? To unpack this question further, we need to ask: What are the firmly held beliefs that shape our identity as social-ecological researchers? Are we always aware of these beliefs; how malleable are they? We therefore propose to host a creative discussion highlighting different beliefs, arguing their merits and disadvantages, and through this process explore the

emergent identity of SES researchers in sustainability science. The setting for this creative discussion will be a "games arena" where groups of participants assume opposing identities in a debate. The debate will be made up of a number of quick-fire rounds, each with its own topic of discussion, for example: 1) The role of social-ecological science: advocacy versus objectivity, or: Does it always have to be either or?; 2) Do our backgrounds matter? Social vs. natural science, or: Should disciplinary lines be crossed or blurred? Audience participation will be actively encouraged, and a facilitator will make sure that the pace is kept up throughout the rounds. The objective is not to widen the dichotomies, but to allow us to explore the spaces between them – possible "third spaces" – to better understand our identity.PART II: Learning from place-based case study research (60 min)Many SES young scholars are conducting place-based research, at a variety of scales. What are the tools, approaches, and competencies which are required for effective and engaged social-ecological research? We also wish to reflect on our positionality as researchers who engage with specific local contexts and communities, and the normative goals of equitable sustainability. We propose to engage these questions by sharing insights from specific case studies of place-based research, as well as drawing on the experiences of young scholars who have successfully transitioned into the next stage of their careers. This part of the session will be structured around a diverse collection of speed-talks, followed by a facilitated discussion between panellists and the audience. Panellists will be senior PhD or post-doctoral researchers who will draw on their experiences to address key questions, challenges and opportunities. Proposed speed-talk presentations on case studies (to be confirmed, 5 min each)1. Vanessa Masterson (Stockholm Resilience Centre): Cultural identity and sense of place: perceptions of agricultural decline and labour migration (Eastern Cape, South Africa) Scale: Village. Approach: Qualitative, inductive, participatory assessment2. Dylan Weyers (Rhodes University): A mixed-methods participatory approach to identifying future scenarios for a large scale dam development embedded in a complex, social-ecological system: implications for optimal land-use planning practices (Eastern Cape, South Africa). Scale: Local village and catchment. Approach: Mixed methods, participatory mapping. 3. Johan Enqvist (Stockholm Resilience Centre): Social–ecological underpinnings of urban environmental stewardship: how can we make sense of individual, societal, and biophysical factors when studying pro-environmental actions? (Bangalore, India). Scale: Local-municipal. Approach: Network analysis using both quantitative and qualitative methods. Proposed Panellists (to be confirmed): Laura Pereira (University of Cape Town), Alta de Vos (Rhodes University), Jamie Alexander (Rhodes University), Marta Berbés-Blázquez (York University). Part II of the session will be concluded with a brief discussion on how we can build a more solid network of SES young researchers and maintain these connections, considering the role of the PECS network in keeping the momentum going. The main outcome of this proposed session is the continued evolution of the important self-reflective process that emerging SES researchers have engaged in over the past two years. The session organizers will synthesize key insights from this session into a blog post, allowing young scholars who were unable to attend the PECS conference to share in the experience. We would also like to explore the possibility of using an online communication platform to make this session available for live viewing by those unable to attend. Participants: Organizing committee: Jessica Cockburn (jessicacockburn@gmail.com), Vanessa Masterson (vanessa.masterson@su.se), Odirilwe Selomane (OSelomane@csir.co.za). Proposed session participants include: Maike Hamann, Nadia Sitas, Gregg Brill, Ilse Kotzee, Hayley Clements, Ryan Blanchard, Linda Luvuno, Petra de Abreu, Karina Benessaiah, Marta Berbés-Blázquez, Jamila Haider, Rodrigo Oyanedel, Megan Meacham, Caroline Schill, Dylan Weyers, Johan Enqvist.

**Talk Title** **COLLABORATIVE TRANSFORMATIONS TOWARD ECOSYSTEM STEWARDSHIP: A DIALOGUE BETWEEN THEORY AND PRACTICE**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Georgina Cundill

Country South Africa

Abstract Background Efforts to address global environmental change encounter complex, interlinked social-ecological challenges. The search for solutions to climate change, biodiversity loss, biosecurity risks and resource depletion is colliding with the need to address social justice, inequality and food insecurity, and the compound effects of highly uncertain but profound systemic connections among these issues. 'Solutions' to these challenges are invariably only solutions for some people, in some contexts, and can impose costs on others. Solutions at one scale can also create further environmental and/or social problems at other scales. Collaboration is potentially critical for transformations towards socially just ecosystem stewardship as a means of path generation that engages and respects multiple views, values and struggles to define what is "just", and what constitutes "ecosystem stewardship". Drawing on transdisciplinary research with partnerships in cases from a variety of developing and developed countries, this panel will reflect on the potential role of collaboration in assisting groups and networks to navigate these challenging issues in shifts toward ecosystem stewardship. The session will focus on highlighting the contributions which insights from practice and transdisciplinary practice-research partnerships can make to developing a theory on collaborative transformations towards ecosystem stewardship. Session objectives• Present a review paper that has been developed through a transdisciplinary engagement process;• Reflect on the conceptual framework in light of case studies, and use these case studies to further develop the framework• Create the basis of a special issue on the role of collaboration in transformations toward sustainability more broadly. Proposed approach7 speakers, 10 minutes each, 30 minutes open discussion. Panel SpeakersConfirmed:Dr Georgina Cundill – Collaborative transformations toward ecosystem stewardship. This paper presents a review of three concepts that are at the core of socially just and ecologically safe pathways toward sustainability: ecosystem stewardship, transformation and collaboration. Based on this review, we develop a conceptual framework to guide empirical investigations of collaborative transformations toward stewardship on the ground. Dr Cathy Robinson – Collaborative knowledge-action system transformations to share stewardship for

environmental risk: Perspectives from Northern Australia. In this paper we draw on the emergence of multi-scalar, cross-cultural, and cross-tenure collaborative governance regimes that have been established to create institutional pathways to negotiate the nature of water quality and biosecurity risks affecting North eastern Australia. We show why and how a collaborative governance system can help build a shared understanding of the environmental problem and agreed course of action, but achieving this requires work.Jessica Cockburn - 'Landscape Mobilisers' build platforms for collaboration to improve stewardship: lessons from South Africa. This paper presents insights from the practice of stewardship in a multifunctional landscape in South Africa, where both conservation and agricultural priorities need to be addressed. Insights from this process contribute to an understanding of how transformative, collaborative processes can contribute to improved ecosystem stewardship. Ashish George – The operation of social spaces in Vembanad Lake, India. This paper will consider the potential contribution of the concept of social space to understanding collaborative transformations toward ecosystem stewardship. The paper will do this by considering the Vembanad Lake in India, focussing on the inclusion and exclusion of different actors such as fishers, framers and tourism operators over time as visions of what the Lake 'should' provide for local communities has shifted. Dr Chinwe Ifejika Speranza / Boniface Kiteme – Collaborative management and governance of water resources in the Upper Ewaso Ng'iro basin, Kenya - opportunities and challenges. This paper discusses collaboration between various stakeholders in water resources management in the Upper Ewaso Ng'iro basin Kenya. It identifies the challenges and opportunities in collaborative water management approaches in the basin and the triggers for change towards more equitable water resources management in the basin.Dr Lisen Schultz - Ecosystem stewardship in Swedish biosphere reserves – from conflict to collaboration. This paper compares the history of ecosystem stewardship emergence in two Swedish biosphere reserves, with a focus on the interplay between change agents and evolving opportunity contexts. We discuss the role of conflict and collaboration in ecosystem stewardship of dynamic landscapes in the Anthropocene.Dr Joanna Bezerra – Fostering collaboration in contested landscapes: land rights and identity in collaborative transformations toward stewardship in South Africa. This paper reflects on inter-generational differences in identity and place attachment and the implications of this for collaborative management at the Great Fisher River Nature Reserve in South Africa. The paper takes issue with simplistic depictions of 'community' and the 'state' in discussions regarding who collaborates, for what purpose, and at whose cost, in transformations toward ecosystem stewardship.

**Talk Title** **INTERROGATING A THIRD SPACE: HOW CAN WE THINK ABOUT METHODS FOR UNDERSTANDING SOCIAL-ECOLOGICAL SYSTEMS?**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Alta De Vos

Country South Africa

Abstract Convenors:

- Rika Preiser (Centre for Studies in Complexity, Stellenbosch University)
- Reinette (Oonsie) Biggs (Stockholm Resilience Centre/Stellenbosch University)
- Alta De Vos (Rhodes University)

Session type: 90 min Topic-contributed session, 3 x 15 minute talks, 25 minute panel discussion and 15 minutes audience questions.

Session description: In the past two decades, there has been a rapid rise in interest and research on social-ecological systems (SES), motivated by the challenges of the Anthropocene and initiatives such as the Millennium Ecosystem Assessment, IPBES and Future Earth. At the heart of SES thinking is the idea that SES transcend a simple combination of social and ecological components and methods and instead investigates an integrated "third space". However, it remains somewhat unclear as to what methods are best suited to interrogating this "third space". Are there existing or new, emerging methods that are particularly suited to understanding SES as integrated, complex adaptive systems or are we still mostly relying on mixed methods to understand social and ecological components of SES? At the heart of these questions lies a deeper question: what is this "third space"? Despite the myriad frameworks, conceptualisations and approaches that exist to define and understand SES in different contexts, it is clear that we don't yet have a strong, shared understanding of the theoretical underpinnings of the SES research field and what this might mean for the way that we research and manage these systems. If we are to tackle the challenges of the Anthropocene and engage substantively with the Future Earth research agenda and ambitions, it is imperative that we start clarifying that nature of this third space and the methods that are appropriate for addressing this agenda.

In this session we propose to have one such conversation by bringing together leading scholars and practitioners who have been thinking about this "third space" and methods for analysing SES from various perspectives. First, four speakers will draw on their own work to explore their understanding of what this "third space" is and how we need to think about interrogating it. An expert panel will then respond to these talks, also engaging with the audience to enrich our collective understanding and progression of SES research and practice.

Session structure and Speakers: Please note that speakers and titles are provisional:

00:00 – 00:05 Introduction (Reinette (Oonsie) Biggs, Stockholm Resilience Centre)

Session Talks

00:05 – 00:20 Complexity and social-ecological systems: A conceptual exploration (Rika Preiser, Centre for Studies in Complexity, Stellenbosch University)

00:20 – 00:35 Methods in Social-Ecological systems: a systematic review. (Alta De Vos, Rhodes University)

00:35 – 00:50 Transdisciplinary and Learning (Heila Lotz-Sisitka, Rhodes University)

00:50 – 01:05 Response to session talks - Berta Martin-Lopez, Autonomous University of Madrid
Patty Balvenena, Universidad Nacional Autónoma de México
Vanessa Masterson, Stockholm Resilience Centre
Garry Petersen, Stockholm Resilience Centre
01:05 – 01:15 Panel Discussion
Audience Question & Answer
01:15 – 01:30 Audience Discussion

**Talk Title** **ONE TABLE TWO MOUNTAINS: A FILM ON WAYS OF KNOWING URBAN NATURE IN CAPE TOWN**
Theme Thresholds, traps and transformations in social-ecological systems
Presenter Dr Henrik Ernstson, Dr Jacob von Heland
Country South Africa
Abstract By Dr Jacob von Heland and Dr Henrik Ernstson
Session at PECS: 45 minute long film screening followed by a discussion with Henrik Ernstson during approximately 30 min. In total the session could be 1.15 min or longer. The session would focus on reactions from the audience on using film as a tool for environmental research in unequal urban ecologies and geographies. Focal questions would be: What does knowledge politics about urban nature and ecology mean in rapidly urbanising and highly unequal cities of the world? What does it mean when we contrast expert-ways of knowing with those of 'non-experts'? And finally, what does it mean to use film as a tool for research to demonstrate and provoke discussions about knowledge politics? Does for instance film bring something that ethnography or more conventional methods of research brings?
Short summary of the film: "One Table Two Elephants." This documentary film is part of the KTH Environmental Humanities and follows on one hand ecologists and 'experts' and how they work to place the urban nature of Cape Town 'in the know', mainly using cartesian scientific practices like maps and GIS. On the other hand the film also traces alternative ways of knowing urban nature. By working with historically marginalised black or so called Coloured communities, the film shows how memories of oppression from colonialism and apartheid 'picks up' plants, wetlands and circulate them through quite different historical experiences to contest how 'urban nature' can and should be known in today's Cape Town. The film is research in itself but also serves as discussion material for students, scholars across the world, and the global South in particular where urban nature and nature conservation forms part of highly unequal and culturally diverse landscapes. The film is made in collaboration between Dr Jacob von Heland (Telltales) and Henrik Ernstson (KTH, UCT).

**Talk Title** **MULTI-SCALE ADAPTATIONS TO CLIMATE CHANGE AND SOCIAL-ECOLOGICAL SUSTAINABILITY IN COASTAL AREAS**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Prof Christo Fabricius
Country South Africa
Abstract Coastal ecosystems are classical examples of complex adaptive systems, which make their management particularly challenging. The drivers of change in coastal areas often act synergistically, with complex non-linear feedbacks across spatial and temporal scales, and between governance systems, users, resources and resource systems. While many adaptations have beneficial outcomes, some adaptations may result in unintended consequences for vulnerability, either for the decision makers themselves or for other stakeholders. Concomitant with an increase in awareness of the threats of climate change, coastal adaptation plans have become increasingly popular. Plans that take a multi-scale and multi-stakeholder perspective hold valuable lessons for a Good Anthropocene. Promising coastal adaptation plans are developed by looking at multiple focal scales and contexts and with due consideration of their knock-on effects to other scales, stakeholders or areas. Adaptation plans of this nature frequently avoid unintended or unforeseen consequences beyond the focal context or focal scale of monitoring. Adaptation plans that hold promise for a Good Anthropocene focus on all the elements and interactions in a social-ecological system, not just on the biophysical, consider the emergence of new and unforeseen impacts due to cross-scale and within-scale feedbacks, and tend to see adaptation as multi-scale and multi-stakeholder processes. Good adaptation plans and may be an answer to to perverse policies and ill- construed development interventions that fail to achieve their objectives. In this session we will discuss and view adaptation as a key driver, and not just an outcome, of vulnerability. Using conceptual models and examples from three case studies in the UK, South Africa and France, we will explore how decisions often result in unintended consequences or outcomes which end up decreasing vulnerability in the focal context as well as at another scale or in another place, can be avoided. We will also explore "windfall" or unexpected win-win adaptation, e.g. when a policy or action aimed at changing behaviour in one sphere, results in positive in other, unrelated spheres. Thirdly, we will describe pathways into and away from maladaptations, the feedbacks that take place and the learning it generates. We will explore the advantages and obstacles associated with collective action in supporting adaptation projects and transformative programs, and discuss how the limitations can be overcome. The session will conclude with a discussion about * Who is most at risk, who is most vulnerable? * Who gains and who loses when vulnerabilities are transferred? * Which adjustments can make the biggest difference here? SPEAKERSMarty Anderies (ASU)Olivier Barreteau (IRSTEA, France)Katrina Brown (University of Exeter)Christo Fabricius (Nelson Mandela Metropolitan University)

**Talk Title** **FINANCIAL MARKETS AND THE BIOSPHERE – CURRENT DEBATES AND RESEARCH FRONTIERS**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems
Presenter Dr Victor Galaz
Country Sweden
Abstract Format: Moderated Roundtable discussion. Time requirement: 5 presentation * 8 minutes + 30 minutes moderated discussions and Q&A. Total: 70 mins.Host: The Global Economic Dynamics and Biosphere Programme (GEDB) at the Royal Swedish Academy of Sciences.In the past, there have been few reasons to study ecosystem change in the light of the behavior of financial markets. While there are studies exploring similarities between financial and ecological systems as complex adaptive systems, few scholars have explored the complex interplay and linkages between the two. Instead, most emphasis so far has been on investigating how international trade drives ecological change in land- and seascapes. This limited focus is worrisome considering that financial actors (such as large institutional investors, investment banks) and financial instruments (such as commodity indexes and "green bonds") play a significant role in shaping the global economy. At the same time however, there is also a rapid increase of financial "bottom-up" experimentation and initiatives with the intention to change the behavior of financial actors, and redirect financial flows in ways that support sustainability and ecosystem stewardship.In this roundtable session, we will take a closer critical look at these trends, and explore their implications for sustainability and biosphere stewardship in the Anthropocene. The session combines short presentations from scholars and practitioners in this area, with moderated discussions between the speakers and the audience. The ambition is to present new research in this domain, and stimulate a discussion that is explorative and brings to light financial phenomena that are poorly understood by the sustainability science community despite their potential impacts on the biosphere.Moderator: Fredrik Moberg, Stockholm Resilience Centre, Stockholm UniversitySpeakers: How are financial institutions implicated in the Anthropocene –debates and frontiersCecilia Repinski, Science Impact Advisor, The Global Economic Dynamics and Biosphere Programme (GEDB) at the Royal Swedish Academy of Sciences. Understanding Financial "Telecouplings" – Financial actors as change agents of global environmental changeVictor Galaz, Associate professor, The Global Economic Dynamics and Biosphere Programme (GEDB) at the Royal Swedish Academy of Sciences, and Stockholm Resilience Centre, Stockholm University. The Corporate Bond Water Risk Tool –resources for the finance sector to integrate natural capital risks and opportunitiesAnders Nordheim, Programme Coordinator for Biodiversity, Ecosystem Services and Water at the United Nations Environment Programme Finance Initiative (UNEPFI)Central banks and "green" finance – where do these meet? Emanuele Campiglio, Fellow in Environment and Development Economics, London School of Economics (UK). Natural Capital = Financial Capital?Gretchen Daily, Natural Capital Project, Stanford University

**Talk Title** **ADDRESSING POWER IN THE GOVERNANCE AND RESILIENCE OF SOCIAL-ECOLOGICAL SYSTEMS**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Prof Chinwe Ifejika Speranza
Country Germany
Abstract Power and how it obstructs or fosters progress towards an inclusive governance of social-ecological systems, and an equitable access to and use of natural resources, remains a challenging issue to address. Neglecting to focus on power can de-politize the struggles over access to and use of natural resources, especially when linked to resilience, thereby jeopardising transformation of social-ecological systems towards sustainable stewardship. This session thus asks how power influences the governance and resilience of social-ecological systems. How does power play out to the advantage and disadvantage of various actors including influencing research agendas? How do power asymmetries persist and what ways can be used for achieving a more equitable access to and use of natural resources, as well as the maintenance of ecosystem functioning? What are the methodological challenges to addressing power in social-ecological systems research? By focusing on power, it is hoped that papers in this session show-case how power has been addressed in research on the governance and resilience of social-ecological systems.Session objectives: − Show-case how different types of power have been addressed in research on the governance and resilience of social-ecological systems − Reflect on methodological approaches and challenges to capturing power and its dynamics in research on the governance and resilience of social-ecological systems.Presentations:Open submission of abstracts; 4 presentations and panel discussionThis session addresses theme 2 of the conference and focuses explicitly on the question of how "power facilitates or constrains the transformation of social-ecological systems towards sustainable stewardship and what can be done about this".Confirmed speakers and topics:1. Land governance, power and social-ecological resilience in the Caroni Region,Trinidad. Desiree Daniel and Chinwe Ifejika Speranza, Department of Geography,University of Bonn, Germany2. Ecosystem services flows: why stakeholders' power relationships matter. MaríaFelipe-Lucia, Berta Martín-López, Sandra Lavorel, Luis Berraquero-Díaz, Javier Escalera-Reyes, and Francisco A. Comín.

**Talk Title** **TRANSFORMATIONS IN ECOSYSTEM SERVICES DUE TO URBANIZATION**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Prof Harini Nagendra
Country India
Abstract Urbanization is fast reshaping the world, with the majority of the world's population now living in cities. The rapid increase in urban sprawl, unprecedented densities of urban settlements, increasing footprint of cities on the ecological hinterland, and growing teleconnections between cities and distant rural areas are reshaping the capacities of urban areas to provide

ecosystem services essential for human survival, sustainability and wellbeing. This panel is conceptualized as a joint GLP-PECS panel, where we bring together studies of urban land change and of place based ecosystem services to discuss global and local trends of change. Using case studies from cities in India, Australia, sub-Saharan Africa, China, Brazil, and New York, we examine ways to reconceptualise the importance of urban ecosystem services in a future urban planet. The panel is co-organized by Harini Nagendra from PECS, GLP, and Azim Premji University: and David Maddox, from The Nature of Cities Presentation 1: Title: Graying and Greening in Bangalore – Impacts of Urbanization on Production and Recreational Ecosystem Services Presenter: Harini Nagendra, Azim Premji University, Bangalore Presentation 2: Title: Opening the black box: realized and potential ecosystem services in private urban greenspace Presenter: Nancy Golubiewski, Ministry of Environment, New Zealand Presentation 3: Title: Transforming spaces and services constrains livelihoods in sub-Saharan African towns Presenters: Charlie Shackleton & colleagues, Rhodes University, Grahamstown, South Africa Presentation 4: Title: Telecouplings and Ecosystem Services in an Urbanizing World Presenters: Jianguo Liu, Jillian Deines, and Wu Yang, Michigan State University Presentation 5: Title: It is Difficult to take in the Glory of the Dandelion Presenter: David Maddox, The Nature of Cities, New York Presentation 6: Eduardo Brondizio and colleagues, Indiana University: title and abstract tbd

**Talk Title** **ECOSYSTEM SERVICE TRADE-OFFS AND SYNERGIES: PATTERNS ACROSS CASE-STUDIES**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Albert Norström
Country Sweden
Abstract This session will advance previous work launched at a workshop held in Stockholm last January. The workshop brought together researchers representing regional case studies that have investigated ecosystem service trade-offs and synergies within social-ecological units across different landscapes and seascapes. During that workshop, we tried to: i) find typical patterns of trade-offs and synergies among ecosystem services found across the studies; ii) identify shared types of bundles of ecosystem services and whether bundles can be understood as signatures of social-ecological systems; iii) select key drivers of the differences among bundles; and iv) find methods useful to identify ecosystem services, trade-offs, bundles, and drivers across different social-ecological contexts and the data needed to undertake such analyses. In this session, we will focus on the application of the different methods and conceptual frameworks that emerged from the workshop. During the first part, we will present the aim of the session and the advances in five different research lines explored. These lines include key considerations for the assessment of ecosystem services bundles, analyses of ecosystem services and trade-offs across landscape gradients, social-ecological factors explaining differences in ecosystem services bundles, the importance of social relationships in the analysis of ecosystem services bundles, and a framework to synthetize ecosystem service interactions in a range of landscapes. The second part of the session will serve to reflect our learning from the different approaches and caveats, launching new discussions to enrich these knowledge gaps.

**Talk Title** **RECONNECTING PEOPLE AND ECOSYSTEMS IN FRAGMENTED SOCIAL-ECOLOGICAL LANDSCAPES**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Patrick O'Farrell
Country South Africa
Abstract Reconnecting people and ecosystems in fragmented social-ecological landscapes
Convener - Patrick O'Farrell (Natural resources and the environment CSIR, Stellenbosch)
At a global scale significant changes are occurring within social-ecological landscapes, fragmenting them, severely eroding their resilience and expose them to a wide variety of increasing risks. Failure to understand and proactively respond to both changes and risks, as well as embrace the opportunities that are embedded in dynamic social-ecological landscapes can have grave consequences for societies. Reconnecting people and ecosystems and shifting social-ecological landscapes towards more desirable alternative states requires fundamental enhancements to the way we conduct research. Fine scale local learning, experiments which direct our attention towards the repair of these fragmented social ecological systems – reconnecting people, rebuilding trust and repairing ecological infrastructure in the process is one such approach.
We present examples from work at a local scale in catchments where teams of transdisciplinary scientists have embarked on an in depth knowledge generation and learning exercise, which have involved multiple stakeholders and institutions. We provide examples of methods and approaches used in initiating this process, and we reflect on the opportunities and challenges moving forward. These methods included maps as boundary objects, participant observation, participatory mapping, making use of 3rd spaces, and getting to know stakeholders through involvement in their processes and rituals. This has been underpinned by traditional research approaches including social network analysis, understanding the biophysical characteristics and conditions of the study areas and developing models geared towards understanding future potential transformations. This session reflects on the challenges and successes we have had in capacitating everyone involved into taking action, developing a collective identity, and moving towards building a connected social-ecological landscape.
This session will be 90 minutes in length allowing for five 10 min talks and 30 min discussion with session participants.
The presenters and the key focus of these presentations are highlighted below.
1. Knowledge co-production and boundary work: Nadia Sitas (Natural resources and the environment CSIR, Stellenbosch South Africa)
Knowledge co-production is a new area of research and both the theory and techniques used in these processes will be

critiqued laying the foundation for the remaining four presentation focussed on case studies.

2. Walking with stakeholders through catchments: Dirk Roux (SANParks South Africa)

A reflection on a current stakeholder engagement case study which used a variety of techniques to both elucidate key issues, system drivers, and a diversity of knowledge systems. Here both opportunities for collective action and potential obstacles to this are discussed.

3. Modelling tools to support stakeholder co-learning: David Le Maitre (Natural resources and the environment CSIR, Stellenbosch South Africa)

Stakeholder engagements are often hinged on the presentation of scientific work and often this directs further scientific enquiry. This presentation discusses the approaches taken in generating this information, including the use of current ecosystem services models and tools and scenario generation.

4. Stakeholders and participatory mapping: Samantha McCulloch (Nelson Mandela Metropolitan University, Saasveld Campus, George South Africa).

The practicalities of using maps to capture stakeholder data and key landscape issues are reflected on. Maps have in the past been used to generate shared understanding and discussion at the local level. However there are numerous practical issues associated with using this data and integrating it into more formal analysis. We reflect on current attempts within a case study catchment.

5. Enabling environments for collective action across scales: Christo Fabricius & Jeanne Nel (Nelson Mandela Metropolitan University, Saasveld Campus, George South Africa and Natural resources and the environment CSIR, Stellenbosch). Ways of creating enabling environments were stakeholders feel that they are in a position to, and have a desire to enact positive change within a catchment are discussed with reference to a particular case study in the South Cape, South Africa.

**Talk Title** **GASTRONOMIC LANDSCAPES: CAN THE ART OF EATING WELL ENHANCE BIOSPHERE STEWARDSHIP?**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Laura Pereira & Line Gordon

Country Sweden

Abstract While the current food system has been able to increase food security for the bulk of the world's population and enabled substantially lowered household expenditure on food in many countries around the world, it has also come with huge sustainability and health costs. The solution to this will likely not be "more food with less impact". Rather, we need to look for substantially new ways of eating that can enable both health improvements for the world's population, and that strengthens incentives for biosphere stewardship of multifunctional landscapes and seascapes. Gastronomy is defined as "the practice or art of choosing, cooking, and eating good food". In this session we look for innovative perspectives that link gastronomy to enhancement of land- and seascape multifunctionality. We mix examples from both high- and low- income countries; where in the former we focus particularly on whether a gastronomic interest can open up space for management of food producing land- and seascapes in ways that enhances the value of ecological knowledge behind the production of high quality products in ways enhances other values (ecosystem services) of those regions. In low-income countries we focus more on how people can get better access to high quality nutritious and culturally relevant food, by managing landscapes for nutrition rather than production per se. Increasing food literacy through working with chefs is important in both these contexts.

Proposed speakers and session set-up:In this session we mix presentation by practitioners from the culinary field with presentations by academics
Loubie Rousch- Making Kos (12 minutes)
Why are we ignoring our local gastronomical gems?
Laura Pereira: University of Cape Town (8 minutes)
Chefs as innovators of agro-biodiversity
Zayaan Khan- Slow Food South Africa (12 minutes)
Rethinking Consumption
Line Gordon and Carl Folke: Stockholm Resilience Centre (8 minutes)
Gastronomic Landscapes: a new framework
Mzu Zele, Unathi Dyanti, Chuma Mgcoyi- Tyisa Nabanye (12 minutes)
Tyisa Nabanye: experimentation in urban permaculture
Fabrice DeClerk: Bioversity International (8 minutes)
Nutrition Sensitive Landscapes

**Talk Title** **COLLABORATIVE SYSTEMIC INQUIRY AS A CRITICAL COMPONENT OF SOCIAL-ECOLOGICAL GOVERNANCE AND RESILIENCE BUILDING.**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Sharon Pollard

Country South Africa

Abstract The USAID-funded RESILIM-O programme focusses on building resilience in the heavily utilised and economically-important Olifants catchment of the Limpopo Basin. The programme integrates climate change, social, water and biodiversity issues. It provides an opportunity to develop and test the idea that sustainable systemic intervention in a social-ecological system

depends crucially on co-construction and social learning between stakeholders across appropriate networks. This is true at and between multiple levels, including the particular level offered by this meeting. The AWARD team will set up an innovative two-hour participative session which will use the systemic and collaborative principles employed in the catchment program. Session attendees will be able to interact with and learn from the process, but as importantly, will be able to contribute to the programme by assisting AWARD as collaborators in developing and testing these ideas. This may entail fundamental changes in perceptions of what sustainable governance should entail. Existing governance arrangements have largely failed to achieve effective Integrated Water Resource Management, achieve complex adaptive goals or apply reliance principles in the SES dynamics of the Anthropocene. So what is new here? The resilience assessment process we run (and are adapting as we learn together) has many elements found in approaches grappling with similar perceived complexity. Particular emphases here, include very wide contextual screening done collaboratively, in which values are treated as formative drivers, not simply preferences. Co-construction continues with the building of concept maps to build mutual understanding between very different parties, and then continues with risk and vulnerability analyses. These build on mainstream approaches, but preferentially conceptualise risk and vulnerability via reflection on the concept map, hence using a state-change paradigm - from a "this is how it is" to "this is how it could rather be" diagram (a "better world" according to key values). A key innovation at this point is the unpacking from the concept map of underlying practices (including governance issues), which forces all concerned through to the practical reality of and motivation for implementation under differing scenarios.

**Talk Title** **SEEDS OF GOOD ANTHROPOCENES**
Theme Thresholds, traps and transformations in social-ecological systems.
Presenter Dr Rika Preiser
Country South Africa
Abstract The scale of human changes to the Earth have shepherded us into a new planetary era – the Anthropocene. In this new geological era, humanity faces profound social and ecological risks, including the possibility of crossing critical thresholds that could undermine key functions of the Earth system. These profound challenges are reflected in an abundance of scientific and popular visions of future collapse and hardship. To date, the global change community has produced very few positive visions of more desirable, just, and sustainable future global outcomes for society and nature, or strategies that identify how to achieve such desirable futures. Although utopian visions exist, these visions typically are neither rigorously developed nor richly articulated. We posit that a cultural dominance of negative visions likely inhibits the ability of people to act to create positive futures due to both an absence of goals and a disincentive for collaborative action towards those goals. This session presents the "Seeds of Good Anthropocenes" initiative that is soliciting, exploring, and developing a diverse set of plausible visions of futures that are socially and ecologically desirable, just, and sustainable. Such futures will likely be radically different from the world in which we are currently living. This sort of imagining can be extremely difficult because it goes far beyond small improvements to the way we currently do things. The initiative aims to scope out possible pathways to radical change by identifying potential seeds of positive futures that already exist in the present. Identifying where elements that could contribute to a Good Anthropocene already exist, what makes them bright spots, and understanding how and why they occur, can help us envision how we might grow them to create new, positive futures for the Earth and humanity. Structure of session: • Introduction and rationale: Oonsie Biggs/Garry Peterson (10 min) • Methods and tools for analyzing seeds: Laura Pereira (10 min) • Emerging insights from the global survey of seeds: Ciara Raudsepp-Hearne (10 min) • Emerging perspectives from southern Africa: Rika Preiser (10 min) • An innovative and interactive process to gather seeds from the audience (35 min) • Reflections on initiative from 3 invited panel members and discussion with audience (15 min) List of participants: Dr Oonsie Biggs Stockholm Resilience Centre (Sweden) & Complex Systems in Transition Centre (South Africa) oonsie.biggs@su.se Prof Garry Peterson Stockholm Resilience Centre (Sweden) garry.peterson@su.se Dr Laura Pereira University of Cape Town and Complex Systems in Transition Centre (South Africa) pereira.laura18@gmail.com Dr Ciara Raudsepp-Hearne ciara.rh@gmail.com Dr Rika Preiser Complex Systems in Transition Centre (South Africa) rika@sun.ac.za Dr Albert Norström Stockholm Resilience Centre (Sweden) albert.norstrom@su.se

**Talk Title** **THE VALUE OF LANDSCAPE STEWARDSHIP FOR MANAGING SOCIAL-ECOLOGICAL SYSTEMS**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Dr Christopher Raymond
Country Denmark
Abstract Recently IPBES proposed a socio-ecological systems framework for connecting nature and people which recognises a bi-directional interconnectedness between ecosystem services and well-being. This framework emphasizes the important role of governance and institutions for articulating the interactions between social-ecological system components. It remains a challenge to assess the link between human well-being and governance and management of ecosystem services. The landscape stewardship concept is a promising metaphor for understanding such linkages; however, there is a lack of coherence about what landscape stewardship means and how to operationalize it within the context of place-based conservation. This session aims to explore some of these challenges, with the goal of addressing the PECS Conference Theme of "How governance and institutions affect social-ecological systems, including capacity for learning and transformations." Specific objectives of the innovative session are to: 1) Explore different understandings of landscape stewardship that have emerged in different case examples; 2) Compare and contrast methods for assessing landscape

stewardship, and the links between the stewardship of ecosystem services, governance regimes and human well-being; and 3) Identify future research directions for landscape stewardship research. Six panel speakers will present a perspective on landscape stewardship (5 minutes each). Following presentations, we will encourage a 90 minute panel discussion between the audience and panel speakers about a range of alternative methods and approaches for conceptualising and measuring landscape stewardship in accordance with the three objectives. These ideas will be documented in preparation for a follow-up landscape stewardship workshop proposed to occur in Europe in early 2016. The session will include the following panel speakers and perspectives on landscape stewardship: Christopher Raymond and Tobias Plieninger (Landscape Planning); Erik Andersson (Social-ecological Resilience); Maria Tengö (Community-based Natural Resource Management; Georgina Cundill (Multi-level Governance); Carl Folke (Ecosystem Management); and Christo Fabricius (Conservation Practice).

**Talk Title** **TOWARDS NEW APPROACHES FOR SUSTAINABLE DEVELOPMENT PLANNING**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Dr Belinda Reyers
Country Sweden
Abstract The Sustainable Development Goals global policy framework provides a timely opportunity for new research and practice that promotes a more integrated approach to sustainable development planning. Such social-ecological approaches will be necessary to realize the new vision for sustainable development that is resilient in ecological, social and economic terms. In this session we will present selected use cases exploring the frontiers and future directions of integrated social-ecological approaches in development planning at multiple scales. These uses cases span the developed and developing world and highlight innovative approaches and policies in use today. The session provides an opportunity to share learning between these use cases, and will explore links to the implementation of the SDGs and opportunities presented by the SDGs to accelerate the use of social-ecological systems thinking and approaches.

Farooq Ullah (Director Stakeholder Forum and Future Earth Engagement Committee) - Implementing the Sustainable Development Goals: the role of science in fostering integrated approaches (10 minutes)
Anne Guerry (Chief Strategy Officer and Lead Scientist, Natural Capital Project, Stanford University) - Sustainable development planning through explicit consideration of nature's services: progress and new frontiers (15 minutes)
Bonnie Keeler (Lead Scientist, Natural Capital Project, University of Minnesota) – Equity and environmental change in an urbanizing world (15 minutes)
Nadia Sitas (Senior Scientist, Council for Scientific and Industrial Research, South Africa) – Exploring knowledge co-production for sustainable development planning in South Africa (15 mins)
Odirilwe Selomane and Maike Hamman (PhD Students, Stockholm Resilience Centre & Stellenbosch University) – Measuring sustainable development with social-ecological data and indicators (10 minutes of 2 x 5 minute speedtalks)
Panel discussion on reflections and future directions from practice and theory: Mark Ruckelshaus (Director Natural Capital Project), Jeanne Nel (Chief Scientist, CSIR), Debra Roberts (Head Environmental Planning and Climate Protection Department of eThekwini Municipality), Farooq Ullah (Director Stakeholder Forum), Carl Folke (Director Beijer Institute) (30 minutes)

**Talk Title** **BIOCULTURAL SYSTEMS IN THE ANTHROPOCENE – HOW TO BUILD ON EXISTING CONNECTIONS BETWEEN PEOPLE AND NATURE IN DEVELOPMENT INTERVENTIONS?**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Dr Maria Tengö
Country Sweden
Abstract Introduction:
In the Anthropocene we live in an increasingly connected world, with cross-scale interactions influencing ecology as well as societies in local places. At the same time there are concerns for an increasing dis-connect and failure to recognize our dependence of societies on ecosystems. There are repeated calls for the need to re-connect with nature - to learn and develop governance systems that can sustainably manage the dynamic ecosystems upon which human well-being depends. However, as has been shown across many disciplines, there are many places in the world where local knowledge, management practices, institutions and belief systems have co-evolved with ecosystem dynamics, enhancing local resilience and the capacity to generate a broad suite of ecosystem services. These systems are not static or isolated but part of the Anthropocene and as such are influenced by cross-scale drivers such as climate change, market globalization, and modernization. In this session we ask: How may we critically study, recognize and nurture such biocultural systems as "seeds of the good Anthropocene"? What can we learn from the dynamics of biocultural systems to facilitate recovery and re-connection for stewardship of landscapes?
What do we mean by biocultural systems? In this context, we present a working definition that emphasizes biocultural systems as governance systems that embrace and addresses social-ecological feedbacks, mediated by culture(s) that is(are) embedded in a specific landscape (place-based), and that have a strong component of local/traditional ecological knowledge (see Berkes and Folke 1998 and Gavin et al. 2014). In many cases, interventions for conservation or agricultural development, are based on a misinterpretation or lack of recognition of the social-ecological linkages in biocultural systems. This can lead to failed outcomes and in the worst case, substantial decline of well-being in communities.
We propose a 120 minute innovative session to critically reflect upon biocultural systems as a specific kind of social-

ecological system as well as to examine ontologies and methodological approaches to study them, and the role of specific interventions that may undermine or strengthen biocultural linkages/assets. There is a romanticizing narrative around certain biocultural systems described as “almost gone” or “sustainable”. We include case studies that clearly show that these systems are dynamic in the Anthropocene – not only in the sense that some biocultural linkages may be lost, but also that these systems are rapidly evolving and provide opportunities for innovation.
Presentations (70 min: 30 min + 30 min in two sets of presentations + 10 min discussion)
The presentations will reflect the different parts of the conceptual paper which we will produce from this session starting with introduction, and conceptual background from different perspectives:
- Maria Tengö (Stockholm University): Linking and navigating social-ecological systems – the role of local and traditional knowledge
- Michelle Cocks (Rhodes University): e.g. Biocultural approaches to neotraditional human-nature interactions
- Stephan Barthel (Stockholm University): Biocultural refugia in the Anthropocene
Following this, there will be short presentations of three case studies that illustrate tight social-ecological feedbacks in rural biocultural systems that are in transition following significant socio-political changes and other social and ecological driver. These presentations will also reflect on the concepts, epistemologies and methods used to conduct research in biocultural systems and their implications.
-Vanessa Masterson (Stockholm Resilience Centre): Connections to rural “home” landscapes of the former Transkei homeland, South Africa
o Using participatory methods such as photo voice to explore sense of place
-Jamila Haider (Stockholm Resilience Centre): Response diversity in biocultural systems: A case from the “Roof of the World”
o Using food as a method in development practice
- Proposed third case study (not confirmed): Rural development in post-socialist Romania, e.g. Friederike Mikulcak/Andra Ioana Milcu (Leuphana University):
Discussion (30 min group discussions + 20 min plenary discussion)
We propose a world café style set of group discussions around three themes:
1. Critical reflection on biocultural systems as a concept: how does it relate to social-ecological systems? What are key differences and complementarities? How is it valuable?
2. What ontologies and methodologies are useful for studying biocultural systems? What are their benefits and limitations in understanding cross-scale interactions?
3. Biocultural leverage points: how can these potential seeds of the good Anthropocene be better understood and framed for use in policy and interventions? How can development proceed without eroding the biocultural diversity that is the engine of innovation in these landscapes? To finalize the session, the groups will present back key insights and perspectives to the plenary. The session will feed into a conceptual paper to be outline in preparation to the conference.

**Talk Title** **INTEGRATING FINDINGS FROM PLACE-BASED RESEARCH ON ECOSYSTEM SERVICES AND SOCIAL-ECOLOGICAL DYNAMICS ACROSS SCALES**

Theme Theme 3

Presenter Dr Tomas Vaclavik
Country Germany

Abstract Conveners: Tomas Vaclavik, Ralf Seppelt.
Meeting the needs of a growing population, while at the same time minimizing the impact to the environment, is critical for sustainable land management and provisioning of ecosystem services (ES). Integrating social-ecological dynamics into ES assessments increases our understanding of the processes that drive land use but these vary from local to global scales. Local place-based research can provide critical knowledge on the biophysical and socio-economic boundaries of land use within a given area. However, the findings are often marginally relevant to places beyond the study region. On the other hand, many land use drivers, such as population growth or climate change, are well captured at the global scale but there are significant uncertainties how they interact with local conditions. Within this complex system, synergies and trade-offs occur at various levels and need to be considered in order to optimize land use and inform policy decisions. In this session, we strive to highlight the link between global challenges and local realities and illustrate how different science-based approaches can help integrate information needed to identify sustainable development paths in social-ecological systems. The issues to be discusses include: (i) integration of local and global drivers in ES assessments, (ii) synthesis of existing concepts for ES assessments, (iii) transferability of results from place-based studies, (iv) quantification of trade-offs between land use and biodiversity and (v) interactions between economic and biophysical processes in land-use studies.
Confirmed speakers:
Johannes Förster: Assessing ecosystem services for informing land use decisions – a problem-oriented approach
Tomas Vaclavik: Using land system archetypes to investigate transferability of findings from place-based research
Stefan Schmidt: Exploring uncertainties of monetary valued ecosystem services
Fanny Langerwisch: Future changes in the provision of ecosystem services in Southeast Asia under climate and land-use scenarios
Leena Karrasch: Land use-based approach to ecosystem services assessment in participatory coastal management processes

Inga Häuser: Ecosystem Service Assessment, integrating multi-, inter- and transdisciplinary results – a case study of rubber production

**Talk Title** **SEEDS OF A GOOD ANTHROPOCENE - THE GAME**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Joost Vervoort

Country United Kingdon

Abstract We propose an interactive game session that focuses on generating creative scenarios about transformations toward a better Anthropocene. The game played in this session has been developed as part of the "Bright Spots – Seeds of a Good Anthropocene" project led by the Stockholm Resilience Centre and supported by Future Earth. The goal of the "Bright Spots" project is to stimulate visionary thinking and action about what a "good Anthropocene" could look like, thinking beyond utopia and dystopia by aiming to identify a wide diversity of current bright spots or seed initiatives that have real potential (through up-scaling or out-scaling, adoption of their principles in other contexts, etc.) for contributing to a good Anthropocene. The identification of these bright spots is one part of the challenge – another challenge is how they can be used to imagine feasible, but fundamentally new and inspiring futures that avoid dystopia and utopia. Out of this need emerged the idea for a scenarios game that provides a mix of building blocks for engaging, challenging but feasible visions of a good Anthropocene. The game is being developed both for physical groups and for large-scale online participation, and combines diverse types of "seeds":

• "Core" social ecological systems (SES) seeds: these are short descriptions of the types of seeds directly relevant to social-ecological systems.

• Economic/political/social seeds: This category includes any current seeds that are not necessarily directly related to SES, but represent innovative practices around core social, economic or institutional dynamics.

• Future seeds: This category contains seeds that mostly exist into the future, as opposed to the more tangible, "proven" seeds in the core/SES category.

• Mind seeds: This category captures any seed practices that do not have a direct, concrete link to real SES, but that focus instead in cultivating the types of "habits of mind" that could be conducive to the development of a good Anthropocene.

To complement these "seed" building blocks, a separate category of building blocks is needed to avoid that the game just leads to utopian thinking, however creative, and to avoid that the game is only concerned with sustainable development, instead of really tackling the challenges of the Anthropocene:

• Anthropocene challenge scenarios: Each building block in this category consists of a short story that summarizes a certain actor's perspective on the challenges that the Anthropocene offers.

The general outline of the game, step by step:

1. Create a large number of cards/post-its/notes for each of the above categories.
2. Select a number of cards at random and give them to groups of storytellers
3. The players who have been given a set of story building blocks discuss how these building blocks work together to create a story (typically blog-length). The story focuses on the SES seed, but considers how the political/economic seed, future seed and mind seeds can be combined with the SES seed to explore new directions in which it can develop. The Anthropocene challenges, likely offering diverse perspectives on the Anthropocene, are discussed together to shape the context of the seeds. The game aims to make incongruity (and cognitive dissonance) productive and create truly new stories of a good Anthropocene that have not been imagined before. This process can lead to new, actionable ideas, as well as new perspectives on how Anthropocene challenges may be interpreted. In the process, players are stepping out of their normal scope of considered futures and are entering unknown territory. The game can be adapted to be used for robustness testing; for exploring interactions between seeds; for collecting seeds; to create inductive scenarios; and as a systems thinking learning tool. The game was first created and played at a December 2014 meeting of the "Bright Spots" project; different adaptations and versions of the game are being tested on-line and in group settings in 2015. We aim for a session with 20-30 players at PECS 2015, using the game to stimulate creative thinking and discussions around the opportunities and challenges for a "good Anthropocene". Session leaders from the group involved in the game design include Joost Vervoort, Oonsie Biggs, Stephen Carpenter, Per Olsson, Victor Galaz, and Albert Norström. Players will be recruited from PECS participants both before and during the conference.

# ORAL ABSTRACTS

*Listed alphabetically – by Surname*

**Talk Title** **A SCIENTOMETRIC ANALYSIS OF SCIENTIFIC DISCOURSE ON THE WORKING FOR WATER RESEARCH PROGRAMME, 1995–2015.**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Mr Brent Abrahams
Organisation Stellenbosch University/ DST NRF C.I.B.
Co-Author(s) Prof. Karen Esler, Department of Conservation Ecology and Entomology, Stellenbosch University and Centre for Invasion Biology (C.I.B) | Nadia Sitas, Natural Resources and the Environment, Council for Scientific and Industrial Research
Country South Africa

Abstract Working for Water (WfW) is a globally recognised ecosystem service scheme to clear invasive alien plants (IAP) from land across South Africa – the world's longest running ecosystem service scheme of its kind. It's a government initiative which seeks to jointly contribute to economic empowerment, social equity and ecological integrity. Its mandate is 'sustainable prevention and control of IAPs, thereby optimising conservation and the use of natural resources and in doing so addressing poverty relief, and promote economic empowerment and transformation'. This paper explores the academic discourse around WfW, specifically its joint goals, focussing on the contributions made by various research disciplines under the auspices of WfW. The use of scientific evidence produced through research plays a limited but essential role in informing the practices of WfW and the adoption of scientifically developed strategies on a wider basis. It's also becoming increasingly important in the development of policies which inform management decisions. WfW's research strategy and action plan emphasise the need for a multidisciplinary approach focusing particularly on the areas of ecology, hydrology, sociology, management, biological control and resource economics in the development of management strategies. Given the scale at which WfW operates, and the complexity of its social-ecological mandate, for WfW to be truly effective and efficient in meeting its mandates, the research conducted under the auspices of the programme needs to be holistic and trans-disciplinary in its approach. Integrative research, provides a wider context which can be used to improve management and policy decisions, and operational success. Research articles related to WfW that mentioned the organization or its synonyms in its title, abstract or keywords; were identified from English language, peer-reviewed journal articles published from 1995 through 2015 and sourced from online journal databases such as Web of Science, Scopus and Springer link, and WfW affiliated research organisations. Using bibliometric information of the publications, i.e. citation and other metadata and though interrogating the full texts, co-authorship networks, research themes and disciplines; co-citation and other bibliographic coupling measures are presented. By unpacking knowledge of how various disciplines have contributed (and the way in which they are linked) to the scientific discourse of WfW, future research opportunities are identified. Additionally, the dynamics and outcomes of interdisciplinary collaborations and research within WfW are mapped. These outputs will identify the extent to which research has been integrative, and will highlight research gaps and opportunities where there could be more inclusive and effective collaboration.

**Talk Title** **EMBEDDING AN ECOSYSTEM SERVICES FRAMEWORK IN APPRAISAL: KEY BARRIERS AND ENABLERS**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Camilla Adelle
Organisation The Centre for the Study of Governance Innovation, University of Pretoria, South Africa
Co-Author(s) Russel,D; Turnpenny, J., Jordan, A., Bond, A., Sheate, W , UK National Ecosystem Assessment Follow-on. Work Package Report 9: Embedding an Ecosystem Services Framework in appraisal: Key barriers and enablers. UNEP-WCMC, LWEC, UK.

Country South Africa

Abstract The Ecosystem Services Framework places a great deal of emphasis on securing a better knowledge of ecosystem functions and processes. But possessing 'more knowledge' does not necessarily mean that it will inform decision-making. This paper argues that one concrete way of embedding an ecosystem services knowledge into the policy making process is to integrate it into policy appraisal systems, which are widely practiced in developed, and increasingly also in developing, countries. In theory, policy appraisal seeks to align individual policies with long-term objectives, is widely advocated by international bodies, and has a long history of engaging with environmental concerns. This paper examines the use (or non use) of an ecosystems framing approach in the UK's policy appraisal system through documentary analysis of 75 individual policy appraisal reports. It finds that in practice the UK consistently falls short of high-level political ambitions to explicitly embed an Ecosystem Services Framework in decision-making. However, while few appraisals are explicitly framed in terms of an Ecosystem Services Framework, many of its constituent elements are often implicitly covered. Key barriers and enablers to embedding the Ecosystem Services Framework in policy appraisal are identified. At the micro level of practitioner behaviour, barriers to embedding the Ecosystem Services Framework include: limited resources available to officials undertaking appraisal (e.g. data, time, money, skills, training and guidance); limited awareness of the concept of the Framework; and difficulty in understanding the concepts underlying the Framework. At the meso scale of institutional culture and practice, barriers to embedding the Ecosystem Services Framework include: fragmented working across departments and levels of

governance; different legal requirements across appraisal levels and types; and narrow focus of appraisals. The paper concludes with some recommendations for greater embedding of an ecosystems services framing into decision making in government. Finally it argues that the whole issue of how the Ecosystem Services Framework could be embedded into decision-making is under-researched.

**Talk Title** **CHANGES IN BIODIVERSITY AND TRADE-OFFS AMONG ECOSYSTEM SERVICES, STAKEHOLDERS AND COMPONENTS OF WELL-BEING: THE CONTRIBUTION OF THE ILTER TO PECS**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Dr Patricia Balvanera
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FATP-IIT; CEH-LEC; ASU; UNT; cE3c-FC-UL; RCSES-UB.
Country Mexico

Abstract The International Long-Term Ecological Research (ILTER) network comprises more than 600 groups within 40 nations with the mission of improving the understanding of global ecosystems and to inform solutions to current and future environmental problems. The ILTER network covers a wide range of socio-ecological conditions and is therefore aligned with the Program of Ecosystem Change and Society (PECS) goals and approach. The aim of this paper is to examine and develop the conceptual basis for proposed collaboration between ILTER and PECS. We describe how a coordinated effort of several contrasting LTER site-based research groups, contributes to the understanding of how policies and technologies drive either towards or away from the sustainable delivery of ecosystem services. This effort is based on three tenets: trans-disciplinary research; cross scale interactions and subsequent dynamics; and an ecological stewardship orientation. The overarching goal is to design management practices taking into account trade-offs between using and conserving ecosystems towards more sustainable solutions. To that end, we propose a conceptual approach linking ecosystem integrity, ecosystem services and stakeholder well-being, and as a way to analyze trade-offs among ecosystem services inherent in diverse management options. We also outline our strategy and methodological approach which includes: i) monitoring and synthesis activities following spatial and temporal trends and changes on each site and by documenting cross-scale interactions; ii) developing analytical tools for integration; iii) promoting trans-site comparison; and iv) developing conceptual tools to design adequate policies and management interventions to deal with trade-offs. Finally, we highlight the heterogeneity in socio-ecological setting encountered in small subset of 15 socio-ecological research groups. These study cases are diverse enough to provide a broad cross-section of relevant ecosystems with: different policy and management drivers of ecosystem conversion; distinct trends of biodiversity change; different stakeholders' preferences for ecosystem services; and diverse components of well-being issues.

**Talk Title** **SOCIAL-ECOLOGICAL DYNAMICS OF ECOSYSTEM SERVICE INTERACTIONS IN THE MONTEREGIE, QUEBEC, CANADA**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Dr Elena Bennett
Organisation McGill University
Co-Author(s) Andrew Gonzalez, Martin Lechowicz, Jeanine Rhemtulla, Sylvestre Delmotte, Delphine Renard , McGIll University, University of British Columbia
Country Canada

Abstract Agricultural landscapes can provide multiple ecosystem services, including food, freshwater, opportunities for recreation, and flood control. Yet we often focus narrowly on the production of food, which can unintentionally undermine provision of other key services. A key goal for science in the coming decade is to improve our understanding of how multiple services are provided across agricultural landscapes in order to learn how to produce food without undermining the provision of other services. This information can help us understand whether trade-offs could be reduced or synergies strengthened through management techniques. We set out to test the hypothesis that landscape structure, and, in particular, connectivity of non-agricultural patches, is an important determinant of the provision of multiple ecosystem services in agricultural landscapes. To do this, we developed, and empirically tested, a model that quantitatively links landscape connectivity, biodiversity, and ecosystem services in the Vallée-du-Richelieu MRC (Municipalité Régionale de Comté), an approximately 750 km2 regional governance body involving 13 towns southeast of Montreal. To parameterize the model, we used fieldwork on the impact of forest patches that were either connected to or isolated from other forests to understand the role of landscape configuration on the provision of ecosystem services, including carbon storage, pest control, and agricultural production, and ecological processes such as nutrient cycling, pedogenesis, and herbivory. We also used historical analyses to understand how the relationships between land use and ecosystem service provision might change over time and the mechanisms behind these linkages.Results indicate that ecosystem service provision across the entire region is driven jointly by land-use configuration

as well as composition, and that some services are especially sensitive to landscape configuration. In particular, herbivory, nutrients and pollinator diversity are influenced by the size and connectivity of forest patches in the agricultural milieu in our study region. These results corroborate our theoretical expectations that landscape configuration, and connectivity in particular, is important when modeling provision of ecosystem services in agroecological landscapes. Furthermore, these relationships – among services, and between services and the landscape, shift through time, with bundles becoming more distinct as the land use composition and configuration change differently across our study region. We are using this framework to build practical decision-support tools for local communities to use as they grapple with the challenges of environmental management in the face of local, regional, and global change.

**Talk Title** **SYSTEMS MAPS AND FUTURE SCENARIOS- TOOLS FOR ENHANCED SYSTEMS UNDERSTANDING IN COASTAL KENYA AND MOZAMBIQUE**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Prof Kate Brown
Organisation University of Exeter
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Country Sweden

Abstract Coastal communities in the WIO region live in an increasingly complex and interconnected world where the future is difficult to predict. In this context, dealing with interdependent challenges such as resource degradation and poverty requires understanding linkages between issues as well as uncertain future trajectories. Within the Sustainable Poverty Alleviation from Coastal Ecosystem Services (SPACES) project, we developed an iterative participatory approach and a set of tools (from models to scenarios) to enhance understanding of the coastal social-ecological systems in terms of feedback dynamics, tradeoffs and opportunities for future sustainable poverty alleviation. Experts in the areas of poverty alleviation and sustainable resource management in coastal Kenya and Mozambique were brought together in a set of two workshops aiming to engage stakeholders and collaboratively build system diagrams and future scenarios to explore important aspects of the social-ecological systems and how it might develop in the future. Here we describe the steps followed during the participatory process and preliminary results arising from the combined use of i) a 'structured' tool (fuzzy cognitive mapping) to map the current social-ecological systems and ii) a 'creative' tool (exploratory narrative scenarios) to explore future scenarios to foster systems thinking and enable discussions around trade-offs and levers of interventions for a sustainable future. Preliminary analysis of the system diagrams resulted in a list of 14 overarching themes considered most important for describing the components of the current Kenyan and Mozambican social-ecological system (e.g. Climate change; Ecosystem benefits; Human population). Key insights that emerged from exploratory scenarios in Kenya included the importance of driving forces such as governance, insecurity and the role of education, while for Mozambique these drivers included governance, climate change and oil and gas development. Our results demonstrate how the combination of the different modes of thinking supports the identification of challenges and opportunities for poverty alleviation while fostering complexity thinking.

**Talk Title** **SOCIO-ECOLOGICAL EFFECTS OF FOREST REGIME SHIFTS: IDENTIFYING RESILIENCE THROUGH COMMUNITY-BASED PERCEPTION**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Dr Rafael Calderón-Contreras
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Country Mexico

Abstract Regime shifts refers to changes in the structure and function of Socio-Ecological Systems (SES). The notion of regime shifts is central for understanding the resilience of SES to withstand the impacts of a combination of shocks that trigger both ecological and social problems. However, there is currently a need to provide a better understanding about the effects of regime shifts and tipping points on Socio-Ecological Systems (SES). The objective of this research is to identify the socio-ecological effects of forest regime shifts in the Nevado de Toluca, a protected area in Mexico´s highlands. The nature of the forest shifts identified relate first, to a loss of 40% in Dense forests from 1972 to 2010, and the consequent increase of Semi-Dense and Fragmented forest. It has also been identified an increase in the upper altitudinal limit in which pine forests is growing, presumably due to a modification on rainfall and temperature patterns. The second forest shift, is related to a change in the legal framework for the protection and conservation of the Nevado de Toluca, given that in 2013 a presidential decree changed it from National Park to Protected Area; a change that implies a reduction of the restrictions for extractive activities. This research has found that these forest regime shifts imply a series of changes regarding the way in which local communities are organized when it comes to access to natural resources. Moreover, these shifts have modified the ancient agricultural practices carried out along the year and also the traditional and cultural activities that characterize the indigenous rural identity of the region. This research illustrates how regime shifts can impact not only the ecological, but also the social traits of the protected area; furthermore, it provides insights on how the notion of regime shifts and their perceived consequences can contribute to the general resilience of the SES studied.

**Talk Title** **INVESTIGATING MID-SIZED CITIES IN THE RURAL WESTERN US AS SOCIAL ECOLOGICAL SYSTEMS: THE MILES PROGRAM (MANAGING IDAHO'S LANDSCAPES FOR ES)**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Antonio Castro
Organisation Idaho State University
Co-Author(s) David Rodgers; Colden Baxter; Donna Lybecker; Kathleen Lohse; Donna Delparte; Rosemary Smith; Idaho State University

Country United States
Abstract In the western United States, expansion of mid-sized cities involves shifts in agricultural production and water resource use, along with expanded recreation and other amenity-based uses; these changes are coupled with shifts in societal demands and values. Landscape transformations are occurring against a backdrop of climate change, adding further uncertainty. MILES (Managing Idaho's Landscapes for Ecosystem Services) is an NSF-funded program linking Idaho's universities and stakeholder groups to advance understanding of social ecological system (SES) dynamics and changes in ecosystem services at the interface between urban and rural environments, relate those changes to societal and climate drivers, and provide science-based tools and training to inform policy decisions for the sustainable management of ecosystem services. The program includes place-based SES investigations in three contrasting regions of the state. In each, three overarching questions are being addressed by transdisciplinary teams with backgrounds including ecology, hydrology, political science, sociology, economics, physical and human geography, history, public policy, urban planning, computer sciences, communication and visualization. Key questions are: 1) What are the patterns of ecosystem services change associated with settlements in each region, and what is the magnitude and rate of ecosystem change? 2) How do societal and climate drivers influence changing patterns of ecosystem services, and how do human communities respond to these changes in ecosystem services?, and 3) How will these ecosystems and associated ecosystem services likely change into the future and what are the key decisions that may alter those trajectories? With the aim of learning via comparison to investigations from other regions of the world, here we present research focused on the Portneuf River Watershed near Pocatello, Idaho, USA. The river is strongly influenced by sediment and nutrient inputs associated with land use, channelization for flood control, and especially water diversions for agriculture, all of which affect the range and character of ecosystem services it provides to the surrounding community. Surveys of stakeholders and the urban public reveal growing interest in restoring the river to regain a wider array of ecosystem services than have been valued in the past, but highlight mismatches between perceptions of factors driving river conditions versus those identified via ecological analyses (which, like irrigation withdrawal, often originate in rural areas upstream). Our findings, along with visualizations of both past and future scenarios, are informing planning efforts, and, in turn, the outcomes of a public visioning process are being used to guide strategic new SES investigations

**Talk Title** **A BASIC NEEDS APPROACH TO UNDERSTANDING THE COMPLEX LINK BETWEEN COASTAL ECOSYSTEM SERVICES AND HUMAN WELLBEING**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Tomas Chaigneau
Organisation University of Exeter
Co-Author(s) Dominique Gonçalves, Universidaded Eduardo Mondlane | Siran Offman, CEPAM | Caroline Abunge, Wildlife Conservation Society | Sarah Coulthard, Northumbria University
Country United Kingdom
Abstract Ecosystem service research typically starts from ecosystems and then identifies what benefits they deliver to people. This paper explores the merits of the opposite: studying individuals' wellbeing first, and investigating how coastal ecosystems contribute to its different components. A multitude of frameworks now exist which depict the array of wellbeing domains that should be included in any assessment. There also exists considerable debate as to the extent to which the selection of domains should be expert led, or derived from the perspectives of those individuals whose wellbeing is of interest, empowering people to align the way their lives are assessed with their own priorities and values. As part of the ESPA funded SPACES project, which is working to establish how marine ecosystem services can contribute to greater human wellbeing in coastal East Africa, a method was developed to create consensus over domains to be used in wellbeing assessment, that combines expert and community perspectives. Drawing from Doyal and Gough's (1992) Theory of Human Need which provides a theorized list of universal criteria for assessing basic needs, a series of focus groups were conducted in coastal villages in Kenya and Mozambique. These discussions validated the Doyal and Gough (expert-led) list, gave opportunity for new additions, and set locally relevant indicators to assess at what point a basic need can be agreed to be met. A second series of focus groups then deliberated the extent to which different ecosystem services that people have access to can contribute, or detract, from the meeting of basic human needs. To better illustrate the process and purpose of the needs approach, we choose an empirical case focusing on the need for education at four sites in northern Mozambique. The paper discusses the merits and pitfalls of the approach, and posits that understanding the role of ecosystem services in the meeting of basic human needs could help inform decision-making by prioritizing those Ecosystem-Wellbeing linkages that people cannot live without.

**Talk Title** **MONEY AND MOTIVES: PRIVATE CONSERVATION AREAS**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Ms Hayley Clements

Organisation Percy FitzPatrick Institute, University of Cape Town
Co-Author(s) Graeme S Cumming, Percy FitzPatrick Institute, University of Cape Town
Country South Africa
Abstract There is a growing involvement of the private sector in the tenure and management of protected areas globally. With government-owned protected areas proving to be insufficient to meet biodiversity conservation targets, it is imperative that we gain a better understanding of the likely resilience of private conservation areas (PrCAs). PrCAs conserve 17% of South Africa's land area, yet little is known about their objectives or their ability to achieve these objectives. We assessed (a) whether profit generation is an important objective for PrCAs, (b) what strategies PrCAs employ to achieve this objective, and (c) if they succeed in doing so. 74 PrCA owners in the Eastern and Western Cape provinces were interviewed. 70% rated profit generation as an important objective, with their 2013 financial returns ranging from operating losses of $200 000 to operating profits of $1.5 million. A hierarchical cluster analysis of PrCA characteristics identified three distinct business strategies. Small nature reserves offer inexpensive accommodation, unguided activities and target local visitors. Large reserves with "big game" (megaherbivores and large carnivores) offer expensive accommodation, guided activities and target international tourists. Large reserves supporting a high diversity of game species offer hunting to international tourists. "Big game" reserves generated the greatest profits and were more effective at meeting their financial objectives than hunting reserves. While nature reserves generated lower profits than big game and hunting reserves, they were also significantly less likely to have financial objectives. These findings suggest that in order to assess the long-term viability of PrCAs, we need to consider their financial objectives as well as if and how they achieve these. Achieving financial objectives requires meeting target market demands. Therefore, local and/or international tourist preferences are likely to influence ecological management within a PrCA (e.g. the quantity and type of species stocked, with risks of overstocking charismatic or extralimital species). These management choices will, in turn, feedback to the likelihood of tourists visiting the PrCA, influencing its financial viability and further ecological management. Such cross-scale interconnectedness, between an international tourist market and within-reserve ecological management, may thereby have significant implications for PrCA resilience to both broad-scale socioeconomic changes and local-scale ecological changes.

**Talk Title EXPLORING TRADE-OFFS BETWEEN AGRICULTURAL PRODUCTION AND BIODIVERSITY**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Anna Cord
Organisation Helmholtz Centre for Environmental Research - UFZ
Co-Author(s) Michael Strauch; Martin Volk; Andreas Dittrich; Ralf Seppelt; Helmholtz Centre for Environmental Research - UFZ
Country Germany
Abstract Background: Growing human population coupled with higher per capita consumption of food, water and energy resources has led to accelerating pressures on the Earth's ecosystems and to multiple competing demands for land. The resulting demand-driven land use changes come at a cost in the form of trade-offs (functional relationships) between biodiversity conservation, food or bioenergy production and other ecosystem services.Objective: The aim of this study is to disentangle and quantify the trade-offs between agricultural production and biodiversity depending on different land use compositions and configurations.Methods: The study considers both artificial and real landscapes (located in Central Germany) for which agricultural production and biodiversity are modeled depending on different land use compositions and configurations using statistical and biophysical models. Input data on agricultural production are derived from agricultural statistics at district level. As biodiversity metrics, species richness data of vascular plants and birds are considered. The models are integrated into a multi-objective optimization routine (using the Python inspyred library) which simulates numerous different spatially-explicit solutions for changes in land use and accordingly estimates values for agricultural production and biodiversity. The 'optimal' (non-dominant) solutions along a Pareto front are then analyzed regarding trade-offs between agricultural production and biodiversity.Results: The multi-objective optimization routine allows (1) exploring a landscape's potential to maintain a high level of agricultural productivity while at the same time ensuring the conservation of the considered taxa and (2) studying the interactions among biodiversity and agricultural production depending on land use composition and configuration. The obtained results therefore provide valuable information regarding limitations to the multi-functionality of landscapes.Conclusions: Quantitative knowledge about land use-dependent relationships between agricultural production and biodiversity is fundamental to promote a better understanding of ecosystems and to provide insights into alternative strategies of land management that may minimize trade-offs. As such, the simulation results are an important source of information to inform discussions.

**Talk Title INTERMEDIARIES AND LEARNING IN SUSTAINABILITY-ORIENTED URBAN TRANSITIONS: A TRANSDISCIPLINARY CASE STUDY FROM STELLENBOSCH MUNICIPALITY**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Ms Megan Davies
Organisation School of Public Leadership, Stellenbosch University
Co-Author(s) Prof Mark Swilling, School of Public Leadership, Stellenbosch University
Country South Africa
Abstract The increasing prominence of and competition between cities elevates the challenges and potential of transformative urban governance. However, as demonstrated by a transdisciplinary research exploration based in Stellenbosch, a prominent university town in Stellenbosch Municipality, realising an urban socio-technical transition demands thoughtful and strategic

attention to the governance context in which regime transformation arises. Following the experiences of an embedded transdisciplinary researcher, situated within a wider process of transdisciplinary research engagement in Stellenbosch, in tracking the evolution of a unique urban governance arrangement, this paper investigates the role of intermediaries and learning in sustainability-oriented urban transitions. It elaborates on the dynamic nature of this unfolding process and highlights potential lessons or applications for other urban governance practices, particularly small- to medium-sized cities in Southern Africa. SM aims to position itself as a leading and innovative African city-region, yet it is faced with a myriad urban sustainability challenges, experienced predominantly in Stellenbosch—SM's largest urban node. This complex dynamic hinders the realisation of a more ecologically sustainable and economically inclusive development trajectory. In response, a unique governance arrangement between the university and municipality, namely the Rector-Executive Mayor Forum has resulted in two sub-committees—the Integrated Planning Committee and the Infrastructure Innovation Committee which have met bi-monthly since November 2013. Constituting municipal officials and political representatives, private sector players, and university researchers and administrators, the IIC and IPC represent the coming-together of a diverse array of stakeholders and related visions, objectives and perceptions. Having been invited to actively partake in this unfolding collaboration and inspired by a transdisciplinary conception of knowledge, the researcher's explicit objective was to become embedded in an existing intermediation space. This made it possible, through careful listening and relationship- and trust-building, to articulate a problem statement reflective of the stakeholders' shared understanding of the issues at hand. It became apparent that a lack of adaptive capacity underpinned the municipality's challenges in effectively fulfilling its mandate and contributing towards a more sustainable and inclusive development trajectory. The research explored how within spaces of intermediation, the process of collaboration and learning within the IIC and IPC, was structured, how it unfolded and to what extent it contributed towards the coordination of actors and the access to resources. Grounded in a pragmatic reality and values that support sustainability, the IIC and the ICP function as intermediary platforms for collaboration and learning that support integrated planning and demonstrate in reality the kinds of innovative governance experiments requires for sustainability-oriented urban transitions.

**Talk Title** **CULTURES OF NATURE: EVOLUTION OF HUMAN SOCIOCULTURAL NICHE CONSTRUCTION AND SOCIAL-ECOLOGICAL DYNAMICS ACROSS THE ANTHROPOCENE**
Theme Thresholds, traps and transformations in social-ecological systems.
Presenter Prof Erle Ellis
Organisation University of Maryland, Baltimore County
Country United States
Abstract Behaviorally modern human societies have transformed biodiversity and ecosystem functioning across most of the terrestrial biosphere. Sociocultural niche construction explains the unprecedented emergence, scale and dynamics of human societies as a transformative force within and across the biosphere based on ecosystem engineering, niche construction, cultural evolution, ecological, cultural and material inheritance, ultrasociality, and social change. Sociocultural niche construction explains why human societies and their transformation of ecology have scaled up over the long-term through sociocultural evolution of cooperative ecosystem engineering, social specialization, nonkin subsistence exchange, and energy substitution, producing long-term changes in the patterns and processes of biogeography, ecological succession, ecosystem function, landscapes, biomes and the biosphere. Anthroecosystems are introduced as an evolutionary framework coupling sociocultural systems and ecosystems across human generational time in which cultural, material, and ecological inheritances are selected for and against and thereby accumulate, are lost, and recombine over extended time periods to produce societal and ecological dynamics. Anthroecosystems change both through gradual processes of selection, accumulation, attrition and recombination and also by more rapid regime shifts in subsistence regimes and social organization. Long-term evolutionary changes in anthroecosystems can explain the dynamics of populations, communities, ecosystems, and landscapes across the terrestrial biosphere as a function of societal change and social centrality interacting with land suitability across biomes. This theory of anthroecology presents new social-ecological frameworks for ecological science including anthroecological guilds, anthroecological succession, anthrosequences and anthromes. Sociocultural niche construction arose with behaviorally modern human societies more than 50,000 years ago and continues to the present day. While sociocultural niche construction, like biological evolution, is a process, not a destiny, some general long-term trends are clear. Increasing societal capacities for social learning, social change, and energy substitution over time are well established by historical evidence and these capacities appear to be enhanced to some degree in larger scale societies, indicating that societally beneficial responses to unprecedented environmental and social challenges may be overcome by novel societal adaptations, albeit often with negative unintended consequences for nonhumans. By more thoroughly investigating and understanding the strengths and limitations of sociocultural niche construction, societies may better predict and manage anthroecological changes through adaptive regime shifts towards better outcomes for both societies and nonhuman species.

**Talk Title** **EMERGENCE AND SPREAD OF SOCIAL-ECOLOGICAL FIT IN MANAGEMENT OF URBAN LAKE NETWORKS**
Theme Thresholds, traps and transformations in social-ecological systems.
Presenter Mr Johan Enqvist
Organisation Stockholm Resilience Centre
Co-Author(s) Maria Tengö; Flor Luna; Örjan Bodin; Stockholm Resilience Centre
Country Sweden

Abstract This paper seeks to develop an empirically grounded understanding of how urban environmental stewardship is linked to social–ecological features of the landscape. In Bangalore, India, decades of rapid urbanization have destroyed and degraded the city's previously locally managed water supply system of interconnected lakes. Recent studies have revealed that a handful of local initiatives have created a new approach to lake restorations that share management responsibilities and cater to a wider range of ecosystem dependencies (Nagendra 2010, Luna 2014). This study is based on interviews with a broader set of more recently initiated lake groups (n=29), and analyzes the mechanisms that enable or prevent horizontal spread (imitation of and learning from previous initiatives) and vertical upscaling (networking, collaborating, and coordination of activities) of civic engagement in stewardship activities. Combining new methodological approaches to study social–ecological networks (Bodin & Tengö 2012, Bodin et al. 2014) with methods to trace histories of social innovations (Abernethy et al. 2014), we seek to answer the following research questions: What are the patterns of connectedness in lake group interactions and water flow between lakes? Where and why do lake groups emerge, and what factors are associated with different steps in successful lake restoration? What are the processes of scaling up transformative changes to reach different levels of governance? We expect to find significantly higher levels of inter-group collaboration between lake teams working with lakes linked by waterways, since ecological connectivity implies a need to coordinate efforts. We expect to find a correlation between successful lake initiatives and connectivity with other lake groups, since "accomplished" projects often share experiences and help people that want to repeat their work elsewhere. We also expect a higher rate of success in smaller, upstream lakes since the task of removing sources of pollution is more straightforward compared to larger downstream lakes with more extensive drainage areas. Overall, this study will contribute to understanding how social–ecological factors influence how initial stewardship engagement can spread and scale up in the context of a rapidly changing city in the global South.

**Talk Title** **SHAKING THE SHACKLES: REWIRING RIGIDITY TRAP DYNAMICS IN URBAN WATER GOVERNANCE THROUGH CIVIC ENGAGEMENT IN LAKES**

Theme Thresholds, traps and transformations in social-ecological systems.

Presenter Mr Johan Enqvist
Organisation Stockholm Resilience Centre
Co-Author(s) Maria Tengö, Stockholm Resilience Centre
Country Sweden

Abstract This study seeks to understand how trap-like dynamics can emerge, develop, and be counteracted in urban social-ecological systems. India's booming IT capital Bangalore currently struggles to meet a rapidly growing water demand while relying primarily on a single source outside the city. The previously used system of interconnected lakes for local water harvesting has been mismanaged and destroyed or polluted by sewage. With a strong focus on one solution while ignoring alternatives, highly stressed system with low heterogeneity, the system displays characteristics that scholars in sustainability science associate with rigidity traps (Gunderson & Holling 2002, Carpenter & Brock 2008). Lately, however, the emergence of locally based citizen groups has questioned this development by shifting focus back to local lakes and decentralized management. The study explores this case using Boonstra & de Boer's (2014) perspective of traps as temporal processes, with the aim of understanding the emergence of and possible ways out of trap-like situations in ecosystem governance. Historical dynamics are studied through a literature review, complemented with semi-structured interviews (n=45) with public officers and local citizen groups currently working to restore and reconnect Bangalore's lake system. Findings identify a critical juncture in the 1960s, when several events precipitated the self-reinforcing feedbacks that trapped the system in continuous investments in external supply while degrading local sources and ignoring the extensive reliance on and overexploitation of groundwater sources. The formation of lake groups has changed this. By relieving and complementing authorities' resources and capacities, they create incentives for involving local citizens for longer- term maintenance and for restoring both ecological and other functions of lakes. While challenges remain to reconnect the lakes as a network, the spread of lake groups could enable the system to dismantle trap dynamics and create more viable water supply solutions.

**Talk Title** **WHAT HAPPENS WHEN 'ENVIRONMENTAL STEWARDSHIP' TRAVELS THE WORLD? ON KNOWLEDGE POLITICS, ACTIVISM AND GOVERNMENTALITY**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Henrik Ernstson
Organisation KTH Environmental Humanities Laboratory, KTH Royal Institute of Technology; African Centre for Cities, University of Cape Town
Country Germany

Abstract My intention with this conference paper is to present two provocations on how we think and treat "environmental stewardship". The first provocation is that the term might be too narrow in capturing all those social groups that are of interest in understanding how the social and ecological are interrelated in urban areas. Departing from an emerging trend to study "environmental stewardship" using social network analysis in US cities (Dana Fisher et al), I contrast their studies with my research group's network survey of 129 organisations in Cape Town. Based on this empirical base, I demonstrate that a narrow "environmentalist" focus downplays both the number of organisations that engage in 'green' spaces and fundamental networked processes of social mobilisation. The second provocation is that the broader use of "stewardship" in environmental studies, which carries an explicit normative connotation and with its origin mainly from global North institutions and contexts, might work to diminish important dimensions of what those we are studying are up to. Based on ethnographic work in Cape

Town, a deeply unequal city with legacies of colonisation and racist town planning during apartheid, activists are acutely aware how 'nature' and the 'environment' is connected to elitism, elite spaces, and elite or expert professions. The notion of "stewardship" or "environmental champions", which is frequently used by NGOs, State authorities and researchers alike, might depoliticise how environmental issues are connected to deeper issues of social change, equality and democracy. Both provocations serve towards a reflection on our practice of environmental science and contributes to theoretical discussions on environmental stewardship where the context of the global South is a crucial 'testing point' to interrogate how scientific concepts 'travel' and the knowledge politics they give rise to when they face new contexts.

**Talk Title** **INTERACTIONS BETWEEN ECOSYSTEM MANAGEMENT AND PEOPLE'S VULNERABILITY TO CLIMATE VARIATIONS IN TWO INDONESIAN FOREST LANDSCAPES**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Mr Giacomo Fedele
Organisation AgroParisTech
Co-Author(s) Bruno Locatelli, CIFOR Peru | Houria Djoudi, CIFOR Indonesia
Country France
Abstract The effects of climate change have already been felt in many parts of the world and are expected to increase over the next decades, affecting sources of revenue and exacerbating poverty. In times of extreme climatic events, the literature has often indicated that forests play an important role as livelihood safety nets and natural buffers. However, it remains unclear how land-use changes affect people's vulnerability and how climate variability influences people´s decisions regarding land use, especially in forested rural areas. We examined social-ecological systems' interactions and dynamics in two smallholder dominated rural landscapes in Indonesia affected by multiple climate-related stresses, such as floods, drought and disease outbreaks. These interactions were analysed through mixed quantitative and qualitative participatory approaches, including 28 focus group discussions, 256 household surveys, and 120 forest inventories. To assess land-use changes, we analysed historical and future trends combining geospatial information with people's perceptions and visions. The findings suggest that communities' recognition of changes in environmental conditions, climate variability and their linkages encourage active management of natural resources and ecosystems to address climate-related hazards. In particular, because of the perceived role of forests and trees in watershed regulation and erosion prevention, people started maintaining or enhancing the vegetation cover in strategic places, such as hilltops, near cultivated areas or along rivers. In addition, people's previous exposure to climatic stresses and resource scarcity seem to increase the adoption of land-based solutions. Although climate considerations only partially influenced land-use changes undertaken by communities, they helped to determine how current land uses are managed, which in turn have a great potential to affect climatic risks. Other external factors included technological improvement and market prices, whereas internal factors were presence of alternative opportunities and land accessibility. An improved understanding of the linkages and trade-offs between land uses and people's vulnerabilities and their changes over time, can inform the design of appropriate ecosystem-based interventions that contribute to a sustainable resilient development.

**Talk Title** **ECOLOGICAL RESTORATION AND LARGE DAM CONSTRUCTION: INHERENT SOCIAL-ECOLOGICAL TRADEOFFS, CONTRADICTIONS AND SOLUTIONS**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Helen Fox
Organisation Rhodes University
Co-Author(s) Georgina Cundill, Rhodes Univeristy
Country South Africa
Abstract The construction of large dams can trigger large-scale social-ecological change. Despite well documented negative social and ecological impacts, the construction of such dams is often presented as an opportunity for social development and, in South Africa at least, ecological restoration. For example, the high lying Ntabelenga catchment, in the Eastern Cape, South Africa has been earmarked for "development" where government has indicated that the construction of a multibillion large dam will commence by 2017. This rural catchment is predominately home to Xhosa speaking people, and has one of South Africa's last free flowing rivers. There will therefore be substantial ecological and social impacts with some villagers being moved and/or losing prime grazing land. Consequently the Department of Environmental Affairs has secured funding to undertake a large-scale ecological restoration project to reduce siltation of the dam. Of necessity this restoration project will involve working with local people to encourage a change of livelihood practice, particularly management of cattle. In this paper we draw together lessons from around the world, but with a particular focus on South Africa, to illuminate the social-ecological trade-offs and deep contradictions that are at play in such settings. The research draws on three sources of information: a desk top-top review, expert interviews, and rural community workshops in contexts that have experienced ecological restoration processes linked to dam construction in other parts of South Africa. In surfacing trade-offs and contradictions in this paper, we also highlight potential solutions and ways of purposefully working with affected communities to seek synergies in such contexts. Our aim is to identify the means to support affected communities to secure transformations toward desired futures in the complex contexts of large dam construction such as that planned for the Ntabalenga catchment.

**Talk Title** **THE ROLE OF ACTORS' VALUES, BELIEFS, AND IDENTITIES IN AN INTEGRATED WATERSHED MANAGEMENT PROJECT**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Mr Raphael Gaus
Organisation Swiss Federal Research Institute WSL
Co-Author(s) Matthias Buchecker, Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Economics and Social Sciences | Adrienne Grêt-Regamey, ETH Zurich, Institute for Spatial and Landscape Development, Planning of Landscape and Urban Systems
Country Switzerland

Abstract Integrated approaches to managing natural resources and hazards are often characterized by high complexity, ambiguity, and uncertainty. For instance, integrated watershed management usually includes a variety of partly competing elements related to the governance of social-ecological systems (SES), such as ecological restoration, nature and landscape conservation, risk management, land improvement, water quality enhancement, hydropower, tourism, and regional development. Accordingly, this kind of management requires the participation of diverse actors sharing different competences and interests in decision-making. However, in such multifunctional management systems, actors often have dissimilar perspectives on the problem based on their respective values, beliefs, and identities. If participation is not well designed, this diversity of perspectives is likely to constrain knowledge exchange and consensus building, and may therefore cause conflicts and result in delays, suboptimal compromises, or even the failure of a project. In this paper, we study how the perspectives of various directly participating and indirectly involved actors in an integrated watershed management project in the Swiss Alps are linked to their values, beliefs, and identities. First, we conduct semi-structured theory-generating expert interviews with relevant stakeholders in the selected case study. In these interviews we also include participatory drawing tasks to elicit the interviewees' mental models. Second, based on the first qualitative findings, we carry out a standardized survey on the different stakeholders' perspectives. We analyze the collected data by systematic qualitative coding of interview transcripts and statistical analysis, notably cluster analysis and ANOVA, of scanned questionnaires. We conduct our research in a case study which includes broad participation of diverse stakeholders. In a series of deliberative workshops they develop technical and institutional measures to manage water resources in the regional SES. The paper offers insights into perspectives of different governmental and private actors on water resources, integrated watershed management, and participatory governance affecting the SES. Furthermore, the role of values, beliefs, and identities in influencing such perspectives is categorized and systematically analyzed. First results indicate agreement about the importance of participatory water resources and risk management but disagreement about processes, priorities, measures, and benefits of integrated SES governance. The findings provide a basis for further research, in which comparisons with data collected at an advanced stage of the participatory watershed management project in the future will be drawn. This will allow for conclusions about possible changes in actors' perspectives and help understand processes of social learning with regard to the sustainable development of the whole SES.

**Talk Title** **MAKING THE CONNECTION: LINKING BIODIVERSITY, ECOSYSTEM SERVICES AND HUMAN WELL-BEING IN SOUTH AFRICA**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Ms Maike Hamann
Organisation Stockholm Resilience Centre
Co-Author(s) Reinette Biggs; Belinda Reyers; Stockholm Resilience Centre
Country Sweden

Abstract An understanding of the relationships between biodiversity, ecosystem services and human well-being is central to addressing the sustainability challenges of our time. Humans depend on ecosystem services for their well-being, and ecosystem service provision is largely dependent on functioning, bio-diverse ecosystems. We used a mapping approach to investigate these linkages at the sub-national scale in South Africa, an ecologically and socio-economically highly diverse country. We drew on publicly available census data to map the use of six provisioning ecosystem services, as well as a bundle of five human well-being indicators at the municipal and district scale. Biodiversity was mapped based on the biodiversity intactness index (BII), which assesses change in population abundance (relative to abundance at a preindustrial level) as a result of human impacts, for different taxa or functional groups and across different ecosystem types. We then analysed the distribution and overlap of the different ecosystem service bundles, human well-being bundles, and the BII at different scales. We discuss trade-offs and synergies between biodiversity and ecosystem services, as well as the impact of biodiversity loss on human well-being. The mapping approach presented here allows a spatial exploration of the fundamental inter-dependencies and linkages between biodiversity, ecosystem services and human well-being, and represents a highly useful tool for decision-makers aiming to secure the welfare of marginalized people that are dependent on natural resources for their livelihoods.

**Talk Title** **ECOSYSTEM SERVICE TRADE-OFFS UNDER FUTURE MANAGEMENT SCENARIOS IN UNESCO BIOSPHERE RESERVES**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Ms Zuzana Harmackova
Organisation Global Change Research Centre AS CR

Co-Author(s) David Vackar, Global Change Research Centre AS CR
Country Czech Republic
Abstract Objective:The aim of our study was to analyze the social-ecological dynamics within selected UNESCO Biosphere Reserves in the Czech Republic by (1) creating participative scenarios of future development in the study areas and (2) assessing their impact on trade-offs between ecosystem services and human well-being. The study also aimed to contribute to long-term social-ecological research (LTSER) activities in the study areas.Background: UNESCO Biosphere Reserves present social-ecological systems with intensive interactions between nature and society, unique for their high cultural and natural values. The UNESCO Biosphere Reserves of the Šumava Mountains and the Třeboň Basin in the Czech Republic comprise some of the most valuable ecosystem types in Europe, including mountain spruce forests and wetlands, which provide a wide array of ecosystem services and sustain high biodiversity levels. However, both areas have been increasingly challenged by various anthropogenic and environmental drivers, including intensive tourism, forestry and fishery demands, growing occurrence of extreme weather events and subsequent pest outbreaks linked to climate change, etc. In addition, these areas have been also facing contrary preferences regarding their management regimes and future development. Therefore, in this study we used the lens of social-ecological systems dynamics to facilitate creating sustainable management strategies for the future.Methods:The methods of the study built on participative approaches and GIS modelling. We employed participative approaches to elicit the preferences of local stakeholders regarding future landscape development of the study areas to 2050. Subsequently, we created an array of scenarios of potential future development of the areas based on the stakeholder input, conveying different levels of landscape protection and exploitation. For each of the scenarios, we utilized various GIS modelling tools and approaches (e.g. InVEST, ARIES) to assess the levels of regulating, provisioning and cultural ecosystem services and analyze potential trade-offs and synergies between them.Results:The results indicate that while scenarios promoting economic development caused substantial trade-offs among ecosystem services, conservational scenarios provided higher levels of ecosystem services with lower trade-offs.Conclusions:This study illustrates that while a large proportion of stakeholders tend to prefer managing ecosystems for short-term economic revenues, incorporating the provision of ecosystem services and their trade-offs in the analysis of potential future landscape management shows that environmentally focused scenarios provide higher long-term benefits. We conclude with emphasizing the importance of stakeholder involvement for building sustainable strategies of future UNESCO Biosphere Reserve management and for facilitating the stewardship of vulnerable social-ecological systems.

**Talk Title SOCIO-ECOLOGICAL TRAP IN MANGROVE FISHERIES OF THE BANGLADESH SUNDARBANS**
Theme Thresholds, traps and transformations in social-ecological systems..
Presenter Dr Mohammad Islam
Organisation Sylhet Agricultural University
Co-Author(s) Farin Binthe Sadeque, Bangladesh Agricultural University
Country Bangladesh
Abstract The Sundarbans is the largest mangrove ecosystem on earth that stretches across Bangladesh and India along the coast of the Bay of Bengal. The Sundarbans is considered the first scientifically managed mangrove ecosystem in the world, which was declared a reserve forest in 1869. Since then, the physical boundary of the Bangladesh Sundarbans has remained mostly unchanged. Interestingly, the hierarchical governance system of the forest has persisted too, with little involvement of local people in management decisions. Due to a lack of defined ownership and established rights, a large dependent population surrounding the Sundarbans has not yet been able to be part of the activities aimed at conserving and sustainably using the forest resources. In the last few decades, in particular, the Sundarbans has been under intense pressure for resource exploitation and the existing governance structure has proven largely ineffective in addressing the issue of sustainability. This calls for an immediate need for transformation. Based on secondary data and qualitative fieldwork in three fishing communities in Satkhira district of Bangladesh, the study aims at exploring 'socio-ecological trap' in mangrove fisheries, which has led to an undesirable state of linked socio-ecological systems in the Sundarbans. Exploring this trap is important as it can create profound implications for the stewardship of ecosystem services of the Sundarbans and its effect might be also difficult to reverse. The result indicates that both social and ecological drivers are involved in creating the trap. Widespread poverty, corruption, subjective insecurity due to criminal gang, lack of economic alternatives, caste system and social exclusion, debt bondage with fish traders, population expansion, overcapitalization in the fisheries, increased demand for mangrove live fisheries in global market are some of the social drivers that push fishers to resort to unsustainable fishing practices in the forest. These social drivers further interact with natural drivers, which are often related to global environmental changes. For instance, cyclone Aila in 2009 forced many Sundarbans fishers to start their livelihoods from scratch and trapped them into poverty and thus created a vicious cycle of poverty and overfishing. The situation is particularly alarming since unsustainable fishing practices in the Sundarbans leave fewer species for the fishers to earn their living, resulting in increased competition and conflicts during harvest. Escaping this socio-ecological trap in the Sundarbans requires transformation in governance structure, one that will focus on restoring ecological diversity, fostering economic diversity given the rapidly changing socio-ecological context.

**Talk Title THE DESIGN AND APPLICATION OF PARTICIPATORY MODELLING IN LINKED HUMAN-ENVIRONMENTAL SYSTEMS. EXPERIENCE AND REFLECTION FROM THE VOLTA RIVER BASIN, AFRICA**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Mr Julius Kotir

Organisation University of Queensland
Co-Author(s) Greg Brown; Ron Johnstone; University of Queensland, Australia | Nadine Marshall, CSIRO Land and Water Flagship, James Cook University, Australia
Country Australia
Abstract Various concerns have been raised at the global scale about the need for sustainable management of complex social-ecological systems in an era of rapid global change. Improving formulation and implementation of sustainable strategies in such systems depends greatly on more integrated and participatory decision-making. In this paper, we present how we designed and implemented a participatory modelling process to address a complex environmental problem within the Volta River Basin in West Africa. Specifically, multiple expert stakeholders worked collaboratively during a 1-day participatory workshop to develop qualitative system dynamic models in a form of causal loop diagrams (CLDs) for the Volta river basin problem. The developed models led to a holistic understanding of the different hydrological, environmental and socio-economic drivers, pressures, and impacts and their interconnectedness and feedback relationships. The results of developed models (CLDs) showed that water availability (water stress), climate change, population growth, land use change, and hydropower development strongly influence the dynamics and sustainability of the basin. After analysing the dynamics within the developed models, stakeholders identified strategies and "leverage points" for intervention within the system including, regular monitoring and assessment key drivers and indicators; investment in ground water irrigation systems; reducing the gain around a positive loop (e.g., small-scale mining, land degradation) while simultaneously improving the self-correcting abilities of the system, specifically, the resilience and adaptive capacity of the system (balancing loops). An ex-post analysis of the process among stakeholders showed that the process has contributed to their collective understanding of the river basin's problems. Participants also rated the process highly and believed that it has improved their individual and collective learning. Based on our experience we present some lessons learned in the design and application of a participatory modelling process in a developing country. These include: keeping it simple, flexible, and focusing on the process rather than the product; engaging not more than 25 participants; involving stakeholders very early in the process; involving stakeholders who are truly motivated and feel the need to be involved and are committed throughout the process; and as a facilitator avoid either intentionally or subconsciously incorporating your own points of view in the process. Methodologically, this case study has demonstrated how we can overcome epistemological challenges as it allowed stakeholders to build their own model of an issue with much less influence from scholars (i.e., the authors). Also, it enriches existing participatory modelling approaches, however, it added new insights to the method by demonstrating how scientific experts (e.g., hydrologists) and local experts (e.g., small-holder famers) can work together in the same learning environment to address a complex environmental problem.

**Talk Title CITIES AS MEDIATORS OF CROSS-SCALE CONNECTIONS IN SOCIAL-ECOLOGICAL SYSTEMS**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Dr Karen Kotschy
Organisation University of the Witwatersrand / Private consultant
Co-Author(s) Daniel Irurah, University of the Witwatersrand
Country South Africa
Abstract Response to reviewer query: The reviewers asked for clarification on what the abstract is based on - a review of existing research or own empirical data? One reviewer felt unsure of the value of a theoretical contribution, stating that "there is already a lot of theory out there". My response is that the abstract is based on a review of existing approaches to studying city-hinterland connections, based on existing literature (as stated in paragraph 3). We agree that there is a lot of theory about cities and complexity, and social-ecological interactions within cities, but work on cross-scale connections involving cities is scattered across many very different disciplines and has not, to our knowledge, been brought together under a social-ecological systems framework. The work to be presented involved significant effort, given the diverse disciplines covered, and we believe this paper has value in making relevant work accessible across disciplines. The focus will be on how the different approaches can be combined and which are most useful for understanding and measuring cross-scale connections involving cities, and will not simply be a summary of existing studies.

**Talk Title FISHERIES-INDUCED EVOLUTIONARY REGIMES**
Theme Thresholds, traps and transformations in social-ecological systems
Presenter Pietro Landi
Organisation Stellenbosch University and International Institute for Applied Systems Analysis
Co-Author(s) Cang Hui, Stellenbosch University and African Institute of Mathematical Sciences| Ulf Dieckmann , International Institute for Applied Systems Analysis
Country South Africa
Abstract Commercial harvesting is recognized to induce adaptive responses of life-history traits in fish populations, in particular by shifting the age and size at maturation through directional selection towards early maturation. In addition to such evolution of a target stock, the corresponding fishery itself may adapt, in terms of fishing policy, technological progress, fleet dynamics, and adaptive harvest. This talk explains how the interplay between natural and artificial selection, in the simplest setting in which a fishery and a target stock coevolve, can lead to disruptive (rather than directional) selection, which in turn may cause stock diversification. To this end, an eco-evolutionary model of a size-structured population is introduced, in which both the stock maturation schedule and the fishery harvest rate are adaptive, while fishing may be subject to a selective policy based on fish size and/or maturity stage. The potential for disruptive selection is studied for different fishing policies, fishing mortality rates, harvest specialization, and demographic and environmental parameters. The following findings are reported.

First, fisheries-induced disruptive selection is readily caused by commonly used fishing policies, provided that the harvest is sufficiently adaptive and large individuals are targeted intensively. Second, when a fish stock is overexploited, fisheries targeting only large individuals might slightly increase sustainable yield by causing trait diversification (even though the resultant yield always remains lower than the maximum sustainable yield that could be obtained under low fishing mortality, without causing disruptive selection). Third, alternative stable states are ubiquitous in the system, and their interplay with disruptive selection makes the evolutionary regimes rather rich. Broad socio-ecological implications of such results are discussed in view of designing evolutionarily-informed fisheries management regimes.

**Talk Title** **SOCIOECOLOGICAL DYNAMICS IN RESPONSE TO URBAN FLOODING AND LAND ABANDONMENT IN NEW ORLEANS FOLLOWING HURRICANE KATRINA**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Joshua A. Lewis
Organisation Stockholm Resilience Centre, Stockholm University, Sweden, Center for Bioenvironmental Research, Tulane University, USA
Co-Author(s) Joshua A. Lewis, Stockholm Resilience Centre, Stockholm University and Center for Bioenvironmental Research, Tulane University | Wayne C. Zipperer, USDA Forest Service | Rebecca Hazen, Center for Bioenvironmental Research, Tulane University | Thomas Elmqvist, Stockholm Resilience Centre, Stockholm University | Henrik Ernstson, KTH Environmental Humanities Laboratory, KTH Royal Institute of Technology and African Centre for Cities, University of Cape Town
Country Sweden

Abstract We analyzed social and ecological factors to explain urban vegetation dynamics in a drainage basin in New Orleans, USA, following urban flooding triggered by levee failures during Hurricane Katrina in 2005. The mosaic of flooding impacts and recovery trajectories provides opportunities to understand how structural and more long-term social and ecological factors intertwined and produced variegated outcomes. We intensively surveyed vegetation in four contiguous neighborhoods in New Orleans and St. Bernard Parish that lie within the Bienvenue Basin, a heavily modified deltaic estuary that was largely inundated for up to three weeks following Katrina. For comparison, we also used vegetation data collected from four neighborhoods with a range of distinct demographic and topographical features. We collected data on human population levels, housing recovery, infrastructure provision, and state sponsored environmental management programs from the US Census, assorted state and municipal government agencies, and interviews with land managers. Our analysis shows that areas subject to highest trauma to vegetation are also subject to the highest rates of vegetation expansion over the decade following Hurricane Katrina.

This indicates that severe and prolonged flooding, post-disaster depopulation, and high rates of land abandonment are combining to drive vegetation patterns in the study area. These dynamics are neither purely social nor ecological, but socioecological and mediated by varying intensities of landscape management in different neighborhoods. We conclude by discussing the implications of these findings for studies of environmental justice and social-ecological resilience in urban landscapes.

**Talk Title** **PARTICIPATORY APPROACHES TO DEVELOP URBAN ADAPTATION STRATEGIES THROUGH ECOSYSTEM-BASED ADAPTATION: THE CASE OF THREE PILOT CITIES IN THE CZECH REPUBLIC**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Eliška Krkoška Lorencová
Organisation CzechGlobe - Global Change Research Centre
Co-Author(s) David Vačkář, Blanka Loučková, Eva Streberová, Zuzana Harmáčková, Jana Frélichová, Adam Pártl, Global Change Research Centre, AS CR
Country Czech Republic

Abstract The study aims to develop suitable adaptation measures in three pilot cities in the Czech Republic - Prague, Brno and Pilsen, while taking into account ecosystem-based approaches to adaptation. We aim to summarize and reflect on climate change vulnerability assessment of these socio-ecological systems as well as the use of participatory approaches in developing urban adaptation strategies that aim to mainstream ecosystem-based approaches. Climate change presents one of the most important drivers influencing natural ecosystems, biodiversity as well as socio-ecological systems. Ecosystem-based approaches to adaptation (EBA) have been recently put forward as a useful approach to buffering the impacts of climate change while sustaining ecosystems and biodiversity (Jones et al. 2012). Although, current adaptation strategies tend to focus more on technical, structural, social and economic aspects of the development, it is natural aspect in terms of ecosystems and biodiversity which can play a significant role in societal adaptation to climate change. Green and blue infrastructure can substantially increase resilience of urban areas. At the same time, these approaches provide a wide range of benefits, such as reducing the flood risk and soil erosion, improved water and air quality, biodiversity enhancement, noise reduction or mitigation of urban heat island effect (e.g. Gómez-Baggethun and Barton, 2013). In this paper we present outcomes of the on-going work of UrbanAdapt project (Development of urban adaptation strategies using ecosystem-based approaches to adaptation). UrbanAdapt project, focusing on urban socio-ecological systems, aims to initiate and further develop the process of preparation urban adaptation strategies in the pilot areas of three large cities in the Czech Republic (Prague, Brno and Pilsen). The methods applied involve vulnerability assessment of the three pilot cities based on future climate scenarios, urban spatial planning and available local data characterizing the urban socio-ecological systems. A review of main benefits and co-benefits of selected urban ecosystem-based approaches to adaptation was conducted.

Participatory approaches, such as participatory workshops, to involve a broad variety of stakeholders influencing decision-making regarding urban adaptation, have been organized in the pilot cities. The results of the participatory workshops indicate that most of the EBA measures have a very high priority among stakeholders. However, the current governance system lacks any legal framework or regulations to support these adaptation measures. In this respect, increasing institutional adaptive capacity would be essential to mainstream EBA adaptation in local decision-making.References:Jones, H. P., Hole, D. G. & Zavaleta, E. S. 2012. Harnessing nature to help people adapt to climate change. Nature Climate Change, 2, 504-509.Gómez-Baggethun, E. and Barton, D.N., 2013. Classifying and Valuing Ecosystem Services for Urban Planning. Ecological Economics 86: 235–245.

**Talk Title** **DO POLICY NETWORKS CONNECT ACTORS WITH DIFFERENT AGENDAS RELATED TO LOCAL AND GLOBAL ECOSYSTEM SERVICES? CASES OF PERU AND BRAZIL**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Bruno Locatelli
Organisation CIRAD-CIFOR
Co-Author(s) Monica Di Gregorio; Leandra Fatorelli; University of Leeds, United Kingdom | Emilia Pramova, CIFOR, Peru
Country Peru

Abstract We analyzed the policy networks related to climate change and ecosystem services in Peru and Brazil to understand how actors working on local or global ecosystem services interact. Climate change requires responses at different scales: at the global scale for mitigation (i.e., limiting the increase of greenhouse gases in the atmosphere) and at local scales for adaptation (i.e., addressing the local impacts of climate change on people and ecosystems). Although many activities can jointly contribute to the climate change strategies of adaptation and mitigation, climate policies have treated these strategies separately. In recent years, there has been a growing interest by practitioners in agriculture, forestry and landscape management in the links between the two strategies but policies rarely address adaptation and mitigation together. Some agriculture and forestry policies, such as REDD+ (Reducing Emissions from Deforestation and forest Degradation), focus on one global ecosystem service for mitigation (carbon sequestration), while others emphasize local or regional ecosystem services for adaptation (e.g. flood reduction in watersheds, coastal protection by mangroves, microclimate regulation in agriculture and cities). Policies for adaptation and mitigation are generally implemented by different agencies, which can led to undesirable outcomes: because of potential trade-offs between adaptation and mitigation, a REDD+ project for global emission reductions can increase the vulnerability of local social-ecological systems; similarly a local adaptation project can increase carbon emissions. There is a lack of information on how climate change policy arenas are polarized along the adaptation-mitigation continuum and how policy actors dealing with local and global issues and ecosystem services interact. We conducted a policy network analysis (PNA) study on the synergies between adaptation and mitigation in Peru and Brazil. The PNA aimed to delineate the relationships (and their structural aspects) between the actors involved in policy processes related to climate change adaptation and/or mitigation in land use sectors (e.g. forestry, agriculture). Results provide a broad picture of actors participating in climate policy processes and identify the relationships of influence and the communication flows between organizations. They reveal how actors concerned with local or global ecosystem services interact differently in terms of communication and collaboration. The PNA is a useful tool for improving policy integration and coherence by mapping out partnerships, identifying new opportunities for collaboration, and detecting bottlenecks. Dialogue and coordination between the different actors (who have different objectives) are essential to balance potential trade-offs and enhance the co-benefits between adaptation and mitigation.

**Talk Title** **NATIVE TREE SPECIES IN FOREST CARBON PROJECTS AS A MEANS TO RECOVER AND ADVANCE SOCIO-ECOLOGICAL SYSTEMS IN AFRICA**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Dr Anne Mette Lykke
Organisation Aarhus University
Co-Author(s) Fatimata Niang-Diop; Mamadou Diop; Bienvenu Sambou; Institute of Environmental Sciences, University of Cheikh Anta Diop, Dakar, Senegal | Michelle Greve, Department of Plant Science, University of Pretoria
Country Denmark

Abstract Objective: To find best practices for tree species selection in forest carbon establishment in order to make forest carbon projects a means to recover and advance socio-ecological systems in AfricaBackground: Landscapes traditionally provided a diversity of ecosystem services that ensured people clean water, fertile soils, shade, wood and a variety of food, medicinal and cosmetic products. During the Anthropocene increasing population density and agricultural intensification gradually reduced the variation of ecosystem services and made people more and more dependent on a few of them with reduced economic and nutritional security as a result. People in rural Africa are often aware and concerned of these changes, but in most cases lack notions and opportunities for action. Planting native tree species in forest carbon projects is a simple, low-cost means to sustain ecosystem services, human wellbeing and favorable planetary conditions at the same time. Methods: A practical approach is taken where research and application is combined. A forest carbon project (called Arlomom) is established as part of an EU financed research project (Undesert). Rural people's priorities for tree species selection are gathered via highly structured quantitative ethnobotanical questionnaires. Data are stored in a database (UseDa), which allows for regional analyses. Present and future species distributions are analyzed using species distribution modelling based on IPCC climate scenarios in order to know if the prioritized native species will be able to grow under future climate

changes, such as declining precipitation.Results: Experiences from a forest carbon project in Senegal show that rural people prioritize planting of native fruit species; local knowledge ensures high focus on food security and subsistence income and thereby poverty alleviation under the present climate. This is not the case under a dryer climate, however, as most of the prioritized tree species presently grow at the dry end of the distribution range. Rural people need advice in order to plant tree species that ensure resistance under climate change. The selection of species for forest carbon projects creates a dilemma of choice between locally prioritized species vs climate change resistant species. Furthermore, many of the locally prioritized tree species are ecological key species, but not all ecological key species are prioritized by local people, so there is also a challenge finding a good combination of social and ecological key species for planting. Conclusions: The best practices for tree species selection in forest carbon establishment have to be carefully discussed among scientists and rural people. With the right species selection, forest carbon projects offer hope for simple solutions for restoring and advancing socio-ecological systems.

**Talk Title** **UNDERSTANDING THE IMPACT OF COMMUNITY-BASED CONSERVATION ON THE PERCEPTIONS OF ECOSYSTEM SERVICES AND HUMAN WELLBEING: INSIGHTS FROM COASTAL KENYA**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Ms Shauna Mahajan
Organisation Stockholm University
Co-Author(s) Tim Daw, Stockholm Resilience Centre
Country Sweden

Abstract Marine protected areas (MPAs) are a social-ecological intervention that while conserving marine ecosystems, also impact communities that depend on marine resources for their wellbeing. Like many conservation strategies, MPAs have historically been implemented and managed in a top-down way that excludes resource-depended users from planning and management. Many of these initiatives have been surrounded by conflict and non-compliance, and consequently the governance of marine resources is increasingly moving towards bottom-up approaches. Community-based MPAs are growing in popularity with the assumption that by putting communities at the forefront of MPA planning and management, more participation will occur, ensuring positive social and ecological impacts. However, little is known about the social dynamics surrounding these initiatives. This study draws on mixed qualitative methods, including a participatory photography method called photovoice, to explore two community-based MPAs in coastal Kenya and understand how each MPA was incepted, and how resource users perceive the impacts of the MPA on ecosystem services and human wellbeing. Participation in and donor support for the MPA were found to influence how resource users perceived the MPAs and their impacts on ecosystem services and human wellbeing. Individuals who were more engaged in the project or held leadership or employee positions perceived more positive impacts on ecosystem services and human wellbeing compared to those not involved. The evolution and management of the MPA in one case was found to be more influenced by outside actors, having implications for perceptions and feelings towards the MPA. MPAs were often viewed by community members as an attractor for outside support and funding, influencing feelings towards conservation. This study supports the theory that the inception phase, or 'step-zero' of a conservation intervention is critical and has the potential to influence perceptions and attitudes long after an intervention has been in place. This study also shows that MPAs are situated within complex socio-political settings, and consequently planning, implementation, and management of such initiatives must take into account the complex social dynamics these initiatives both create and are surrounded by.

**Talk Title** **WHEN THE TEA HITS THE FAN: THE ROLE OF GOVERNANCE AND INSTITUTIONS IN ROOIBOS AND HONEYBUSH PRODUCTION SYSTEMS**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Mrs Rhoda Malgas
Organisation Department of Conservation Ecology and Entomology
Country South Africa

Abstract The rooibos and honeybush industries of South Africa share several commonalities. They are each embedded in social-ecological systems that are spatially distinct, but that constitute similar ecological and social components. Rooibos production amongst small-scale land-users is challenging, but there have been times when they have outperformed their large-scale commercial counterparts in the market. Chronic underproduction is evident amongst small-scale land users in the honeybush industry – this in spite of the increasing demand for biomass from international and local markets, and the livelihood opportunities it represents. Development of the rooibos and honeybush industries run along different temporal trajectories, with the rooibos industry being the more established by 30 years. Despite this seeming advantage, small-scale land-users resided at the margins of the industry until 1999, the same time as when the honeybush industry started emerging. With this paper we explore the governance and institutional structures that exist in the social-ecological landscapes of honeybush and rooibos production systems. We demonstrate by way of two case studies how governance and institutional arrangements influence sustainability of the resource system, and explore the antecedents to those factors across the two industries. We aim to make a modest contribution to SES thinking in the Fynbos, and especially as they pertain to small-scale land-users who derive livelihoods from the resource systems in question.

**Talk Title** **FARM-LEVEL MAPPING OF MULTIPLE ECOSYSTEM SERVICES IN A DIVERSE AGRICULTURAL LANDSCAPE IN THE DRAKENSBERG, SOUTH AFRICA**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Ms Rebecka Malinga
Organisation Stockholm Resilience Centre
Co-Author(s) Regina Lindborg, Department of Physical Geography and Quaternary Geology, Stockholm University | Line Gordon; Erik Andersson; Stockholm Resilience Centre, Stockholm University | Graham Jewitt, Centre for Water Resources Research, Umgeni Water Chair of Water Resources Management, University of KwaZulu-Natal
Country Sweden

Abstract Spatial mapping of ecosystem services is increasing as a practice both in science and policy. So far, most analysis has been performed at large spatial scales resulting in an under-representation of local/landscape scales. This has lead to a gap in the understanding of the finer dynamics needed for small-scale management interventions and local landscape planning. A wide range of ecosystem services have been mapped globally, with main focus on some provisioning and regulating services. Cultural ecosystem services have recently received increased attention in the literature on ecosystem services, although some (e.g. spiritual/religious, cultural heritage, identity, and social relations) are still largely underexplored. The need to include these less tangible ecosystem values is often highlighted, while comprehensive assessments of the links between the ecosystems and human well-being are scarce. This study explores the social-ecological landscapes in two contrasting farming systems (large-scale commercial and small-scale subsistence agriculture) in the Drakensberg, South Africa, through local-level mapping of multiple ecosystem services. We analyze the links between spatial distribution of land uses and supply and demand of ecosystem services, and identify ecosystem services bundles associated with land uses and farming intensity. To explore a wide range of different ecosystem services at farm scale, we use an empirical transdisciplinary method integrating biophysical in situ measurements with participatory GIS techniques and in-depth interviews with farmers. Ten large-scale commercial, and ten small-scale subsistence farmers participated in the study. Water provision, water flow regulation, soil erosion regulation and nutrient retention are estimated using biophysical data previously collected in the area. Crop and livestock production, wild foods, materials and fuels, crop diversity, aesthetic values, spiritual/religious values, cultural heritage, farmer identity, social relations and recreation are interpreted using participatory mapping exercises and in-depth interviews. Pollination, pest regulation and habitat heterogeneity are estimated using available aerial photographs, validated through participatory mapping. All service estimates are expressed using a normalized scale, where the highest expressed value is maximum, at both farm-scale and landscape scale. The results will be used to bring insight in the local conditions needed to discuss management strategies at a landscape level, and to identify aspects required to increase multifunctionality.

**Talk Title** **EXPANDING THE PROTECTED AREA NETWORK IN NAMIBIA: IDENTIFYING AND CATEGORISING STAKEHOLDERS AROUND THE ETOSHA NATIONAL PARK**

Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.

Presenter Ms Lelani Mannetti
Organisation Stellenbosch University
Co-Author(s) Karen J. Esler, Stellenbosch University | Ulrich Zeller; Thomas Göttert; Humboldt-Universität zu Berlin
Country Namibia

Abstract Protected areas are among the most important refuges for biodiversity and are crucial for the conservation of ecosystems. Increasingly, protected areas are being incorporated into the wider landscape in which they occur and a more general awareness is emerging of the relevance of these areas to human well-being. Unlike other countries in Africa, Namibian protected areas are expanding due to the proliferation of conservancies and game reserves. This entails forms of land-use variably dedicated to wildlife management, ranging from trophy hunting concessions, combined livestock and game ranches to reserves promoting only non-consumptive natural resource use. The interface between natural and social systems in protected area governance is poorly understood, however, and we lack methods to assess the social processes influencing conservation decisions. This is particularly relevant when dealing with various forms of land and natural resource use. The objective of this study is to apply stakeholder analysis as a method of integrating local actors into protected area designation and management around the Etosha National Park in Namibia and to estimate their importance in the process. To achieve, we identified and categorised important stakeholder groups, quantitatively and qualitatively assessing their relative salience to the protected area decision-making process. Combining key informant interviews, semi-structured questionnaires, focus groups and participant observation, 12 stakeholder groups were identified, categorised according to proximity to the national park, land tenure and land-use type. Primary stakeholders, comprising livestock farmers, communal conservancy members, resettlement farmers and tourism/hunting enterprises, were individually scored and the cumulative values of position, interest and power calculated for each group. These attributes provide an indication of stakeholder salience and the various roles stakeholders potentially play in protected area planning and natural resource governance in the study area. Our study indicates that livestock farmers, on both private (62,5%) and 'resettled' (72.7%) land (i.e. owned by the state and managed by communities), mostly oppose protected area expansion, yet remain interested in the concept. Other stakeholder analyses focused mainly on stakeholder power and influence in protected area planning and decision-making. By incorporating stakeholder position and interest, in addition to power, we calculated the relative salience of stakeholder groups in protected areas expansion. Stakeholder analysis provides a transparent and repeatable process for identifying and selecting key stakeholders, yet a particular consideration of their position and interest regarding the protected area network in Namibia

can potentially lead to better implementation of conservation areas in the country.

**Talk Title** **COMPETING PLACE NARRATIVES OF SOCIAL-ECOLOGICAL ECOTOPES AND PLACES WITHIN A PROPOSED CO-MANAGEMENT NATURE RESERVE IN THE FORMER TRANSKEI, SOUTH AFRICA**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Ms Vanessa Masterson
Organisation Stockholm Resilience Centre, Stockholm University
Co-Author(s) Maria Tengö, Stockholm Resilience Centre, Stockholm University | Marja Spierenburg, VU University
Country Sweden

Abstract Co-management has been advocated as a way to reconcile the goals of conservation and development in areas of poverty and high biodiversity. However, in South Africa this approach has had mixed success for several reasons, which include local conflicts over resources and a lack of local institutional capacity in the wake of Apartheid. We use 'sense of place' as a lens through which to explore one such conflict in communal land in the vicinity of an indigenous forest. In this case, a proposal to declare a nature reserve in the forest and surrounding grassland that includes abandoned fields, has been unsuccessful thus far. It has been shown that place-attachment is important for predicting action when a change threatens a place. However, it is the meanings of place that determine whether that action will be towards change or to protect the status quo. The objective of this study was to track and assess competing narratives of the place meanings used by different stakeholder groups in their support of or opposition to the nature reserve declaration. We identified 6 land-use types that occur in the proposed forest area, defined in the local language, including indigenous forest, abandoned fields, and areas of Acacia sp. encroachment. Sampled vegetation characteristics show that these indigenous land-use types are based on distinct ecologies. We then conducted qualitative interviews with 25 stakeholders: from the provincial conservation authority, the traditional authorities, and local communities. Interviews assessed symbolic and instrumental meanings of each of the land-use types as well as participant views on the project. We identified several narratives about the proposed reserve project that mobilise different place meanings for competing agendas. For example, for one group, the forest represents the hope of development through the sale of game and ecotourism. In such a view, abandoned fields with no hope of being ploughed should be sacrificed for this goal, as this will increase biodiversity connectivity in the proposed reserve. A contrasting narrative (of those who do not support the proposal) emphasises historical exclusion from this forest under Apartheid. In this narrative these abandoned fields still hold cultural significance for families. We conclude with a discussion on the power of place narratives in resource management dilemmas. Sense of place is a useful lens through which to explore different agendas that may cause conflict in co-management projects, and may offer a way to find common values in such situations.

**Talk Title** **TRADEOFFS IN ECOSYSTEM SERVICES PAYMENTS: WATER, BIODIVERSITY AND CULTURAL SERVICES IN VIETNAM**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Dr Pamela McElwee
Organisation Rutgers University
Co-Author(s) Hue Van Thi Le; Tuyen Phuong Nghiem; Huong Dieu Vu; Center for Natural Resources and Environmental Studies, Hanoi | Nghi Huu Tran, Tropenbos International
Country United States

Abstract An explosion of new market-based policies for ecosystem services (ES) has occurred across the globe in recent years. Payments for environmental services (PES) is one of the most well-known of these policies. However, despite the widespread expansion of PES, fundamental questions have not yet been answered regarding PES's impacts and effectiveness, particularly with regard to governance tradeoffs. For example, the difficulties of measuring some ES has led policymakers to focus on a narrow range of services for PES payments, primarily water provision, leading to questions regarding the tradeoffs that will be required. This paper will explore the problem of ES prioritization and tradeoffs in PES policies using a case study of Vietnam. Based on four years of field research in several provinces that have PES programs that have paid households for forest conservation, the paper will present data from a quantitative panel survey of 225 PES payment recipients, as well as interviews with local and national policymakers on PES. While PES fees are supposed to be collected across a range of environmental services under law, close examination of these projects shows that the difficulties of measuring ES provision has led policymakers to focus on a narrow range of services, primarily water provision, as it is easier to measure and price water ES than for biodiversity, landscape amenity or cultural services. Further, our survey results show that most PES payment recipients are not aware of where the PES money comes from (mostly government collected fees on hydropower and water companies) and subsequently these households do few actions that would contribute to improved water supply and quality. The Vietnam case shows that while water PES may be easier to assess from a policymakers' standpoint, water is an abstract ES for many PES provisioning households, making it difficult to connect conditionality to their payments. Other tradeoffs include the fact that local provinces see PES payments as an incentive for increased hydro-development in the future, but such development often ironically results in forest loss due to reservoir building and reduced water flow for other activities (e.g. tourism). The presented case study will suggest how these tradeoffs should be managed at local and national levels, with implications for other similar PES policies elsewhere.

**Talk Title** **COMPARING REGIONAL ENVIRONMENTAL IMPACTS AND ECOSYSTEM SERVICES DESPITE ENVIRONMENTAL HETEROGENEITY IN DIFFERENT PARTS OF THE WORLD**

Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.

Presenter Mr Markus Meyer
Organisation University of Munich (LMU)
Co-Author(s) Ralf Seppelt; Felix Witing; Joerg A Priess; UFZ-Helmholtz Centre for Environmental Research
Country Germany

Abstract Increasing global trade of forestry or agricultural products raises the question, how local/regional environmental impacts (EIs) or ecosystem services of different locations can be compared. To enable comparisons of the effects of land use activities at various production locations, it is necessary to control for environmental heterogeneity, i.e., the variation of biotic and abiotic conditions. In this study, we use three approaches to control for environmental heterogeneity applying (i) environmental stratification, (ii) potential natural vegetation (PNV), and (iii) regionally set environmental thresholds to compare EIs of solid biomass production, e.g., for bioenergy. We utilize production regions with managed forests and plantation forestry for subtropical (Satilla watershed, southeastern US), tropical (Rufiji basin, Tanzania), and temperate climate (Mulde watershed, central Germany). All approaches allow for comparing the EIs of different land use/land cover (LU/LC) classes between and within production regions and also the EIs with each other. The different approaches rank EIs for LU/LC within a production region according to their naturalness (forest, plantation forestry, cropland). We identified the PNV approach as conceptually the most reliable, but with major deficiencies concerning feasibility and relevance. The PNV approach explicitly includes most of the factors that drive environmental heterogeneity in contrast to the stratification and threshold approach. We also show that stratification based comparison facilitates a concise global application. Regional environmental thresholds only implicitly include environmental heterogeneity varying by individual case and cover only few EIs. Further studies are needed to validate the methodologies for other land use systems and environmental conditions.

**Talk Title** **KNOWLEDGE CO-PRODUCTION AND BOUNDARY WORK TO PROMOTE IMPLEMENTATION OF INTEGRATED SPATIAL PLANS**

Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.

Presenter Dr Jeanne Nel
Organisation CSIR
Co-Author(s) Dr Dirk Roux, Amanda Driver
Country South Africa

Abstract The concepts of knowledge co-production and boundary work offer planners a new frame for critically designing a social process that fosters collaborative and cross-scale implementation of resulting plans. Knowledge co-production involves stakeholders from diverse knowledge systems working iteratively towards common vision and action. Boundary work is a means of creating permeable knowledge boundaries that satisfy the needs of multiple social groups while guarding the functional integrity of contributing knowledge systems. Resulting products can be viewed as 'boundary objects' of mutual interest, which maintain coherence across all knowledge boundaries. This paper shows how knowledge co-production and boundary work were deeply entrenched into spatial planning to bridge the gap between science and implementation, and promote cross-sectoral cooperation around conserving and managing freshwater ecosystems. Knowledge co-production occurred iteratively over four years in interactive stakeholder workshops, which included: co-development of goals and spatial data, translation of goals into quantitative inputs for modelling and selecting draft priority areas, review of draft priority areas, and packaging of resulting map products into an atlas and supporting implementation manual to promote application in 37 different use contexts. Knowledge co-production stimulated cross-scale dialogue and negotiation, and built capacity for multi-scale implementation beyond the project. The resulting maps and information integrate diverse knowledge types of over 450 stakeholders, representing well over 1000 person years of collective experience. The maps provide a consistent national information source that has been applied in 25 of the 37 use contexts since launching 3.5 years ago. When framed as a knowledge co-production process supported by boundary work, regional spatial plans can be developed into valuable 'boundary objects', which offer a tangible tool for multi-agency cooperation and cross-scale implementation of sustainability. This work provides practical guidance for planners interested in promoting uptake of their science, and contributes to an evidence base for reflection on how environmental sustainability efforts can be improved.

**Talk Title** **TRANSFORMATIVE CAPACITY IN THE ANTHROPOCENE: THREE STRATEGIC IMPERATIVES FOR UNDERSTANDING LARGE-SCALE SYSTEMIC CHANGE TOWARDS SUSTAINABILITY**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Per Olsson
Organisation Stockholm Resilience Centre
Co-Author(s) Michelle-Lee Moore, Department of Geography, University of Victoria | Frances Westley; Dan McCarthy; Waterloo Institute of Social Innovation and Resilience, University of Waterloo
Country Sweden

Abstract Transformations are often discussed as necessary to achieve a just society that thrives within planetary boundaries. However, the research of transformations to sustainability, which involves the capacity to solve problems while creating conditions for "the good life" for people, today and in the future, and while simultaneously strengthening Earth's life support system, is still in its infancy. A key question for understanding transformative capacity is: what are the conditions and

mechanisms for achieving large-scale systemic changes and fundamental redirections in people-planet relationships that can have an impact at scales that match the challenges of the Anthropocene, or create a "Good Antropocene"? Although there are promising efforts across disciplines to address these issues, we argue that the Anthropocene construct challenges much of the scholarship that examines change-making efforts to sustainability, including social innovation, earth system governance, resilience thinking, social movement, and transitions management. Drawing on relevant literature and a number of empirical case studies, including marine stewardship and agriculture and food systems, this paper proposes and describes three interlinked, strategic imperatives that are crucial to and could guide studies of transformative capacity, large-scale impact and sustainability transformations in the Anthropocene: 1) Confronting the "Social-Ecological" Challenge - analyzing social-ecological dynamics of transformations and recognizing the urgency of action; 2) Confronting the "Bricolage" Challenge – recognizing the systemic implications of the Anthropocene and the need for clustering and networking of partial solutions to address integrated social-ecological problems; and, 3) Confronting the "Scale" Challenge – recognizing agency and the cross-scalar nature of the issues associated with the Anthropocene and the need for innovations to cross scales at an unprecedented pace. The paper ends with a discussion on how an increased understanding of conditions and mechanisms related to these three imperatives can help to critically examine whether the solutions (including technological and social innovations and initiatives of large-scale change such as the "Green Revolution in Africa" and "Farming the Sea"), currently promoted by various change agents to deal with global sustainability challenges, contribute to the large-scale transformations that humanity needs, or whether they reinforce current unsustainable pathways.

**Talk Title** **EXPLORING THE ROLE OF PROVISIONING SERVICES IN HOUSEHOLDS' RESPONSE TO VULNERABILITY IN THE DRY WOODLANDS OF VENDA, SOUTH AFRICA**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Ms Fiona Paumgarten
Organisation University of the Witwatersrand
Country South Africa

Abstract Rural households in southern Africa's dry forests and woodlands are inherently vulnerable, exposed to multiple stressors. To sustainably manage this vulnerability, many households depend on the goods and services (including provisioning services) the surrounding ecosystem provides. These provide direct benefits, indirect benefits, income-generating opportunities, safety-net functions and possibly contribute to climate change adaptation. Ecosystem change and loss may increase vulnerability, threatening sources of food, raw materials, water and medicine. The provisioning services concept can be used to support conservation and livelihood improvements. This research explores the role of provisioning services in households' response to vulnerability in the woodlands of Venda, Limpopo Province, South Africa. Multiple stressors are considered, including climate variability and change. Past incidences of droughts and floods are explored. Conversely, the impact of increased vulnerability on provisioning services is examined. The ongoing research aims to explore future climate change scenarios and the role of provisioning services in household adaptation practices The research sites include two villages in rural Venda. The villages fall within different rainfall zones, with one receiving notably less annual rainfall than the other. Selecting sites with different annual rainfall, was intended to test how provisioning services, livelihood strategies, vulnerability, coping and adaptation strategies, might differ according to past, present and future climate variability and change. Qualitative and quantitative data on livelihood assets and strategies, vulnerability, coping and adaptation practices were collected. Provisioning services were identified. Methods included 170 household interviews. Community workshops were conducted. Participatory rural appraisal tools including seasonal calendars, time-trend exercises, impact chains and solution trees were employed.Land-based livelihood strategies and provisioning services differ between the sites. Provisioning services play a greater role in the drier site, contributing towards fuel, food and water security. Animal husbandry dominates in this site. These findings suggest past adaptations to climate but questions are raised as to whether they will withstand future changes. Multiple stressors were identified at the household and community levels including historical and seasonal changes in the availability and use of provisioning services. The findings of this research contribute towards an increased understanding of the role of provisioning services in rural livelihoods, and in households' response to climate variability and change. This understanding is needed to enable the sustainable stewardship of social-ecological systems and the services they generate. This is important given the increasing recognition that well managed ecosystems can help households adapt to both current hazards and future climate change.

**Talk Title** **DETECTING POTENTIAL IMPACTS ON ECOSYSTEM SERVICES RELATED TO ECOLOGICAL REGIME SHIFTS – A MATTER OF WORDING**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Mr Juan Rocha
Organisation Stockholm Resilience Centre
Co-Author(s) Robin Wikstrom, Abo Academy University
Country Sweden

Abstract Assessing which ecosystem services are likely to be affected by ecological regime shifts is one of the greatest challenges of current ecological research. Regime shifts are large, abrupt re-configuration of ecosystem's structure and function; they are hard to predict, often difficult to reverse, and present potential changes on the benefits people receive from natural systems impacting human well-being. While a bulk of research comprises localized case studies where data is available and experimentation is possible, a global assessment of regime shifts consequences is missing. Here topic mining is presented

as a complementary strategy to assess changes in ecosystem services at broader time and spatial scale than direct assessments. We explore an indirect approach by using latent Dirichlet allocation to automatically identify topics that align with ecosystem services, and compared it with the impacts reported by contributors to the Regime Shifts Database. We found that identifying ecosystem services is possible, successful detection is correlated to how well studied regime shifts are. While the majority of supporting and regulating services were successfully detected, pollination and cultural services were elusive. The technique provides a new indirect monitoring method for places where current data is scarce or data collection is challenging.

**Talk Title** **REGIME SHIFTS IN THE ANTHROPOCENE: DRIVERS, RISKS, AND RESILIENCE**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Mr Juan Rocha
Organisation Stockholm Resilience Centre
Co-Author(s) Garry Peterson, Oonsie Biggs, Stockholm Resilience Centre
Country Sweden
Abstract Many ecosystems can experience regime shifts: surprising, large and persistent changes in the function and structure of ecosystems. Assessing whether continued global change will lead to further regime shifts, or has the potential to trigger cascading regime shifts has been a central question in global change policy. Addressing this issue has, however, been hampered by the focus of regime shift research on specific cases and types of regime shifts. To systematically assess the global risk of regime shifts we conducted a comparative analysis of 25 generic types of regime shifts across marine, terrestrial and polar systems; identifying their drivers, and impacts on ecosystem services. Our results show that the drivers of regime shifts are diverse and co-occur strongly, which suggests that continued global change can be expected to synchronously increase the risk of multiple regime shifts. Furthermore, many regime shift drivers are related to climate change and food production, whose links to the continued expansion of human activities makes them difficult to limit. Because many regime shifts can amplify the drivers of other regime shifts, continued global change can also be expected to increase the risk of cascading regime shifts. Nevertheless, the variety of scales at which regime shift drivers operate provides opportunities for reducing the risk of many types of regime shifts by addressing local or regional drivers, even in the absence of rapid reduction of global drivers.

**Talk Title** **CULTURAL ECOSYSTEM SERVICES, RESILIENCE AND PLACE ATTACHMENT WITHIN VINEYARDS THREATENED TO BE ABANDONED**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Mr Beni Rohrbach
Organisation University of Zurich
Country Switzerland
Abstract People's reactions on disturbances are influenced by their perceptions and their values. Cultural ecosystem services such as „sense of place" are constantly co-produced between the consumer (the people) and the producer (the ecosystem/landscape). Therefore, these ecosystem services can be changed from the demand as well as from the supply side. Our area of study is a culturally valued landscape of vineyards separated by dry stone walls. As production costs for grapes are quite high in this environment, the vineyards are threatened to be either abandoned or cultivated in a more rationalized manner, which would require the dry stone walls to be partly removed. This would change the cultural values embedded in the landscape. Within this study, we investigate the influence of place attachment and resource dependency on reactions regarding the imminent loss of the cultural ecosystem services „sense of place" and „cultural heritage". Facing such a change, we analyzed reactions of groups of wine farmers separated by occupational level and place attachment. These factors influence the likely reactions, which then in turn affect the landscape and thus the cultural ecosystem services. This grouping was consistent with other studies as well as with our own observation. Apart from different likely reactions, we found that the change in land use has a different impact on the cultural ecosystem services for different people. Some wine farmers we currently would expect not to take any action would suffer a great loss of cultural ecosystem services, while others would proactively change the landscape and through that either conserve or lower the cultural ecosystem services.Our data consists out of qualitative interviews and a map annotation exercise with 33 wine farmers, which was complemented by an extensive literature review. The whole encounter with the grape-farmers was tape recorded, later transcribed and the annotations spatially geo-referenced. The interviews were then qualitatively analyzed through a coding scheme according to Mayring.We conclude that the reactions on the anticipated abandoning of vineyards can be grouped based on the attachment of the people, their social capital and the perspective on the disturbance. Some reactions would adapt the system and maintain many of its present functions, while other reactions would favor a single function over others. The people as well as the natural features are place dependent, therefore, likely reactions are spatially different. This offers the opportunity to target management interventions spatially explicit.

**Talk Title** **THE ROLE OF AGENCY SCIENCE IN OBTAINING THE EVIDENCE BASED FOR CONSERVATION MANAGEMENT AND POLICY**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Prof Dirk Roux
Organisation South African National Parks

Co-Author(s) Richard Kingsford, University of New South Wales | Stephen McCool, University of Montana | Melodie McGeoch, Monash University | Llewellyn Foxcroft, South African National Parks
Country South Africa
Abstract Our goal was to gain insight into the value and contribution of in-house agency science towards informing conservation management and policy.

**Talk Title CROSS-SCALE CONNECTIONS FOR SYSTEMIC CONSERVATION GOVERNANCE: ENABLING FEEDBACKS FROM GLOBAL TARGETS TO LOCAL ACTION AND BACK**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Prof Dirk Roux
Organisation South African National Parks
Co-Author(s) Jeanne Nel, Council for Scientific and Industrial Research | Ruth-Mary Fisher, South African National Parks | Jaco Barendse, Nelson Mandela Metropolitan University
Country South Africa
Abstract This paper aims to provide a better understanding of the technical, institutional, and social processes that play a role in establishing feedbacks across different scales of conservation governance, from global to local and vice versa.

**Talk Title COOPERATION IS NOT ENOUGH – CRITICAL SOCIAL-ECOLOGICAL CONDITIONS FOR SUSTAINABLE MANAGEMENT OF THE COMMONS**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Mrs Caroline Schill
Organisation The Beijer Institute and Stockholm Resilience Centre
Co-Author(s) Nanda Wijermans; Maja Schlüter; Stockholm Resilience Centre | Therese Lindahl, The Beijer Institute and Stockholm Resilience Centre
Country Sweden
Abstract Cooperation is a key factor for sustainable local management of the commons. However, cooperation is difficult to achieve when individual and collective interests are in conflict. To overcome such social dilemmas is far from a trivial task and has attracted and fascinated scholars from various scientific disciplines. This has led to substantial progress on the theory of collective action and the commons. But does cooperation necessarily lead to sustainable management of the commons? The short answer to this question is no. Groups of ecosystem service users must also have knowledge of what sustainable management implies. Even having overcome the dilemma, they face varying degrees of environmental uncertainty and may lack a good understanding of ecosystem dynamics. Nevertheless, most research in this field focuses on “cooperation facilitators” in snapshot-like analyses. In this paper, we combine data from behavioral experiments (common-pool resource game) with an agent-based model (ABM) to explore and advance understanding of collective behavior in respect to critical conditions for sustainable commons management. The experimental results this study is informed by indeed show that cooperation has a positive effect on sustainable management. However, some cooperative groups still over- or under-exploited the resource (or even depleted it). The ABM we developed for this paper can qualitatively reproduce these behavioural patterns. This enabled us to open the black box of individual human decision-making to derive explanations for the observed behaviour. The value-added of this paper is its focus on the interaction between social and social-ecological factors as well as cross-scale interactions between individual and group level. Preliminary results suggest that for cooperation to go hand-in-hand with sustainable management, it is not the individual understanding of the ecosystem dynamics alone that matters, but how this understanding plays out in combination with the environmental uncertainty the individuals perceive and whether or not they feel comfortable enough to share their understanding with others. The study provides insights about critical social-ecological mechanisms underpinning human behaviour, collective action and sustainable resource management which can inform case-study and place-based research, as these mechanisms are crucial to understand the micro-foundations and dynamics of local social-ecological systems.

**Talk Title THE IMPORTANCE OF SOCIAL CONTEXT FOR DETERMINING THE CONTRIBUTION OF ECOSYSTEM SERVICES TO POVERTY ALLEVIATION**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Dr Björn Schulte-Herbrüggen
Organisation Stockholm Resilience Centre
Co-Author(s) Dominique Gonçalves; Vilma Machava; Eunice Ribeiro; University Eduardo Mondlane (UEM) | Andrew Wamukota, Pwani University | Tim Daw, Stockholm Resilience Centre
Country Sweden
Abstract Ecosystem services are considered an important source of income for coastal communities. However, the importance of ecosystem services for the wellbeing of poor communities in coastal East Africa is little understood primarily due to the paucity of studies providing quantitative evidence and assessing the variation in importance caused by social context.Here we present the results of a socio-economic survey of 830 randomly selected rural and urban households from four study sites (Mombasa, Tsunza, Vanga and Mkwiro) along Kenya's southern coast. We assessed the relative importance of different ecosystem services by eliciting the value of monetary and non-monetary production flows from the sites' main ecosystem based activities, namely tourism, fishing, gleaning, farming and harvest of non-timber forest products, and

compared this to the value of non-ecosystem based activities. This allows a quantitative measure of the proportional contribution of ecosystem services to household income, and how the importance of ecosystem services varies based on respondents' social circumstances, such as location (e.g. rural or urban), household type (e.g. male- or female-headed households) and socioeconomic characteristics (e.g. wealth, ethnicity, migration status). Preliminary analysis suggests that individual ecosystem services play a pivotal role for income in some households and that this pattern is strongly affected by social context. This highlights the importance of context specific interventions for improved management of social-ecological systems to achieve both sustainable resource use and development outcomes.

**Talk Title** **BENEFITS AND CHALLENGES OF CROSS-FERTILIZING RESILIENCE ASSESSMENT AND THE APPROACH OF THE TRANSITION MOVEMENT**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Ms My Sellberg
Organisation Stockholm Resilience Centre
Co-Author(s) Sara Borgström, Albert Norström, Garry Peterson, Stockholm Resilience Centre
Country Sweden
Abstract Interest in resilience has rapidly expanded over the past decade, which has lead to an increasing demand for methods to operationalize resilience thinking. The Resilience Assessment is the most developed scientifically based approach to apply resilience thinking, but have been less successful in enabling transformation. The rapidly spread grassroots network of the Transition Movement represents the largest community of practice working with resilience thinking. However, it has been criticized for lacking an adequate framework for applying resilience. Even though these approaches share the Resilience Alliance's definition of resilience, they have never previously been combined in a scientific study. Therefore, we present a novel comparison of these two approaches that analyzes how they can cross-fertilize to enhance resilience assessment practice. Specifically we identify 1) key differences and commonalities between the two approaches, and 2) opportunities and challenges to their cross-fertilization. We have compared them through a qualitative text analysis of their key handbooks, and combined them in resilience assessment workshops in southern Sweden together with a local partner active in the Transition Movement. By complementing the comparison of the widely used handbooks with a practical case study embedded in a specific region, we captured some of the differences between theory and practice. Our findings highlight the possibility to tailor a resilience assessment version that integrates their complementary strengths: The Transition Movement's narrative of the need to transform in response to global sustainability challenges, and practical tools for learning and participation, with the Resilience Assessment's scientifically based framework and process for how to generate context-specific understanding of resilience. Combining the approaches also created synergies in fostering complex systems understanding. However, we also encountered challenges of combining the two approaches, for example in the different expectations of quantitative results, and in balancing their different degrees of normativity. A tailored resilience assessment, that acknowledged these challenges, would be useful for the wider audience of communities and local governments who wish to assess resilience. Our study also shows that transdisciplinary approaches are useful to investigate how resilience can be applied in ways that promote transformation to sustainability.

**Talk Title** **TOWARDS INTEGRATED SOCIAL-ECOLOGICAL INDICATORS FOR TRACKING PROGRESS TO SUSTAINABLE DEVELOPMENT: EXPLORING THE CONTRIBUTION AND GAPS IN EXISTING GLOBAL DATA**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Mr Odirilwe Selomane
Organisation Council for Scientific and Industrial Research
Co-Author(s) Belinda Reyers, Reinette Biggs, Stockholm Resilience Centre
Country South Africa
Abstract Sustainable development goals (SDGs), which recognise the interconnections between social, economic and ecological systems, have ignited new interest in indicators able to integrate trends in- and interactions between- nature and socio-economic development. We explore whether existing global data can be used to measure nature's contribution to development targets and explore limitations in these data. Using Millennium Development Goal (MDG) 1– eradicate hunger and poverty; we develop two indicators to assess the contribution of nature to progress in this goal. The indicators (based on income and employment data from nature-based sectors (NBS) represented by agriculture, forestry and fisheries) show large but declining contributions of nature to MDG 1: NBS contributed to lifting 18% of people out of poverty and provided 37% of global employment between 1991 and 2010. For low income countries, the contributions were 20% and 55% respectively. In exploring data gaps the study highlighted low reporting rates especially in low income countries, as well as lack of other measures of poverty alleviation beyond income and employment. If we are to move beyond target setting to implementation of sustainable development goals at national scales, these shortcomings require as much attention as the elaboration and agreement on the post-2015 development goals.

**Talk Title** **SYNCHRONIZED PEAK-RATE YEARS OF GLOBAL RESOURCES USE**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Prof Ralf Seppelt
Organisation Helmholtz Centre for Environmental Research - UFZ

Co-Author(s) Ameur M. Manceur; Stefan Klotz; Helmholtz Centre for Environmental Research (UFZ) | Jianguo Liu; Center for Systems Integration and Sustainability, Michigan State University | Eli P. Fenichel, Yale School of Forestry and Environmental Studies, Yale University
Country Germany
Abstract Adequate long-term appropriation of planetary resources lays at the heart of sustainable development of human population. Many separate studies have estimated the year of peak, or maximum, rate of using an individual resource such as oil. However, no study has estimated the year of peak rate for multiple resources and investigated the relationships among them. We exploit time series on the appropriation of 27 global renewable and nonrenewable resources. We found 21 resources experienced a peak-rate year, and for 20 resources the peak-rate years occurred between 1960-2010, a narrow time window in the long human history. Whereas 4 of 7 nonrenewable resources show no peak-rate year, conversion to cropland and 18 of the 20 renewable resources have passed their peak rate of appropriation. To test the hypothesis that peak-rate years are synchronized, i.e., occur at approximately the same time, we analyzed 20 statistically independent time series of resources, of which 16 presented a peak-rate year centered on 2006 (1989-2008). We discuss potential causal mechanisms including change in demand, innovation and adaptation, interdependent use of resources, physical limitation, and simultaneous scarcity. The synchrony of peak-rate years of multiple resources poses a greater adaptation challenge for society than previously recognized, suggesting the need for a paradigm shift in resource use toward a sustainable path in the Anthropocene.

**Talk Title IDENTIFYING BARRIERS TO CLIMATE CHANGE ADAPTATION IN SUB-SAHARAN AFRICA: WHAT TRANSFORMATIONS MIGHT BE NEEDED FOR A SOCIALLY-JUST FUTURE?**

Theme Thresholds, traps and transformations in social-ecological systems.
Presenter Prof Sheona Shackleton
Organisation Rhodes University
Co-Author(s) Gina Ziervogel, University of Cape Town | Susannah Sallu, University of Leeds | Thomas Gill; Petra Tschakert; Penn State University
Country South Africa
Abstract In order to respond to the impacts of climate change deeper consideration of the factors or barriers that impede action is required. While there is some discussion of these in the recent literature, knowledge of barriers that hamper adaptation in developing countries remains limited, especially in relation to underlying causes of vulnerability and low adaptive capacity. To improve our understanding of barriers to adaptation and identify gaps in the state-of-the-art knowledge, we undertook a synthesis of empirical literature from sub-Saharan Africa focusing on vulnerable, natural resource dependent communities. Our review revealed a wide range of barriers that prevent poor people responding to climate change and that, when taken together, can seriously undermine both generic (associated with fundamental human development goals) and specific adaptive capacity (associated with climate risk management), possibly presenting limits (intolerable risks) for some. Most of the barriers uncovered related broadly to biophysical, knowledge and financial constraints on agricultural production and rural development. More hidden and under-acknowledged political, social and psychological barriers that can result in relational outcomes were rarely mentioned, unless captured in studies that specifically set out to investigate these. Many of the barriers, particularly if we are to support socially-just responses, can only be overcome through shifts or transformations in the fundamental structural and development processes that drive inequality and marginalisation. We argue that research on barriers needs to start asking why barriers emerge (focussing on underlying causes), how they work together to shape climate change response processes and when they may present limits, who they affect most, and what is needed to overcome them paying specific attention to the factors that contribute to the underdevelopment and adaptation deficit we see in sub-Saharan Africa.

**Talk Title PUNCUATED COMPLEXITY: LONG TERM SETTLEMENT DYNAMICS IN SOUTHERN MADAGASCAR .**

Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Prof Paul Sinclair
Organisation Uppsala University
Country Sweden
Abstract In this presentation I analyze archaeological landscapes in Anosy and Androi in southern Madagascar using a combination of remote sensing and field survey. A long term perspective is provided by time series of archaeological sites projected in GIS coverages. The theoretical approach to complexity draws on the philosophical work of Alfred North Whitehead and Bertrand Russell on logical types in the early 20th century and the anthropological approach to cognitive ecology of Gregory Bateson. Recent developments of systems ecology theory applied to linear and non-linear processes in multi-scalar landscape analysis using ideas of Holling, Gunderson, Folke and Von Helland are important stimulants to our thinking on landscape processes in archaeology e.g. Van der Leeuw, Redman, Crumley and McGlade.

**Talk Title BIODIVERSITY FOR SOCIETY – A REFLECTION ON THE KRUGER NATIONAL PARK AS A BENEFIT PROVIDER AND A BENEFACTOR**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Ms Louise Katherine Swemmer
Organisation Social and Economic Research, Savanna and Arid Research Unit, SANParks

Country South Africa
Abstract This paper aims to investigate the relationships between and impacts of biodiversity conservation and society in the context of the Kruger National Park (KNP), South Africa. South African National Parks strive to connect society and biodiversity through the provision of ecosystem goods and services and the associated benefits that flow from them. Little is known about the multiple scales and impacts of these goods and services, the costs that are sometimes associated with the process of benefit accrual, how to measure these costs and benefits (especially the intangible elements) and how these collectively impact on the multiple dimensions of human well-being. This has important implications for conservationists that manage for societal support, a major objective of benefit sharing – both through compromising the identification and prioritization of fair and appropriate benefit sharing arrangements and in so doing, placing the organisational reputation (and hence sustainability) at risk. This is especially pertinent in a park like the KNP where building local constituency is a priority as a result of the history of forced removals and restricted access that have resulted in lack of support by many neighbouring communities. This investigation therefor aims to audit and assess the current wide variety of tangible and intangible impacts of the Kruger National Park and the cost and benefit tradeoffs that happen at multiple levels. The assessment acknowledges the role that stakeholder world views play in valuing benefits and as a result, attempts to categorise and audit benefits using a multi-stakeholder lens. The assessment is based on a variety of sources, and uses various data collection methods. We conclude that Kruger contributes significantly to well-being both directly and indirectly for a wide variety of stakeholders at both individual and collective levels. In terms of constituency, there is strong support for KNP internationally, but there is still a great need to develop a deeper understanding of how benefit distribution and accrual at a local level, impacts conservation support and behavior. There is a need to focus more on enabling local direct benefits from conservation (currently around 90% of beneficiaries are tourists) through mutually beneficial partnerships with local ownership, to facilitate the conditions necessary to build local support through vested interests. This has implications both for general conservation constituency and for the recent threats linked to the illegal trade in wildlife.

**Talk Title THE MULTIPLE EVIDENCE BASE APPROACH – CONNECTING KNOWLEDGE SYSTEMS FOR GOVERNANCE OF SOCIAL-ECOLOGICAL SYSTEMS**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Dr Maria Tengö
Organisation Stockholm Resilience Centre
Co-Author(s) Pernilla Malmer, Stockholm Resilience Centre | Gathuru Mburu, Institute of Ecology and Culture
Country Sweden
Abstract The rapid acceleration and intensity of global environmental change places great demands on humanity to develop innovative ways and processes for connecting knowledge systems that are conducive to sustainability learning and recognize the complexities of social–ecological systems and the challenges of the Anthropocene. Indigenous and local knowledge systems can provide valid and useful knowledge to enhance our understanding of governance of biodiversity and ecosystems for human wellbeing. This may be particularly true concerning insights for a more in-depth and integrated understanding of how social and ecological processes interact to produce sustainable outcomes in local places. However, connecting knowledge systems presents challenges concerning equity, legitimacy, validity, and scale.

We present the Multiple Evidence Base (MEB) as an approach where indigenous, local and scientific knowledge systems are viewed to generate different manifestations of knowledge, which can generate new insights and innovations through complementarities. MEB emphasizes that evaluation of knowledge occurs primarily within rather than across knowledge systems. Joint processes to define the issue of investigation, mobilize multiple sources of knowledge, and assess convergence and divergence, allow for triangulation and transparent ways to resolve conflicting evidence. We report initial insights from a bottom-up piloting of a MEB approach in two local communities in Kenya, which suggest that the tools and approaches for mobilizing local knowledge are critical, and that successful processes can have a strong implications for improving collaboration across levels of management and lead to positive transformation in governance of social-ecological systems. We propose that MEB is a useful approach for enhancing the relevance and credibility of diverse knowledge systems in PECS case studies.

**Talk Title LINKAGES BETWEEN FOOD SECURITY, LIVELIHOOD SHOCKS, AND NATURAL RESOURCE USE: INSIGHTS FROM A LONGITUDINAL DATASET FROM RURAL SOUTH AFRICA**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Prof Wayne Twine
Organisation University of the Witwatersrand
Co-Author(s) Lori Hunter, University of Colorado (Boulder) | Mark Collinson; Barend Erasmus; University of the Witwatersrand
Country South Africa
Abstract Natural resource use is a common feature of rural livelihoods across the developing world, enabling households to diversify their livelihoods, manage risk, and buffer against shocks such as crop failure and adult mortality. However, the extent to which natural resource use as a coping strategy effectively increases household resilience is less clear. This study explores linkages between food security - as a specific dimension of well-being -, livelihood shocks, and natural resource use in a rural socio-ecological system in South Africa. A panel of 590 households was sampled from nine villages in the Agincourt Health and Demographic Surveillance System site in Mpumalanga Province. Households were surveyed annually from

2010 to 2014 to quantify their livelihood capital, strategies (including use of natural resources from surrounding communal woodlands), experience of shocks, and their food security. Associations between shocks, food security, and natural resource use, after controlling for household socio-economic characteristics, were examined using multivariate mixed-effects models. Roughly sixty two percent of households experienced at least one of ten shocks in the previous year, with most shocks impacting negatively on food security. Increased use of natural resources - particularly wild fruit, edible insects, and fuelwood - was associated with household experience of shocks. Wild fruit and insect consumption appear to be especially important for decreasing shocks' effects on food security. This study demonstrates the importance of local ecosystem services in human well-being and household responses to crises. However, natural resource use on its own does not fully protect households from the negative impacts of shocks, highlighting the importance of multifaceted approaches to reducing vulnerability in social-ecological systems.

**Talk Title** **IMPOSSIBLE OR INEVITABLE: SCALING INNOVATION IN AGRO-ECOLOGICAL SYSTEMS**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Dr Saskia Van Oosterhout
Organisation ACDI associate, UCT
Country South Africa
Abstract This presentation summarises a number of case studies drawn from research into agricultural innovation in Africa. The approach follows the direction of Larry Page, Google's founder, who stated recently that "Much worse than failure is failing to think big. If you're not doing some things that are crazy, you're doing the wrong thing. Products developed for the world in its present state are doomed for failure. We need to take advantage of tools and infrastructure of the future."The common theme of the case studies is that they are oriented to address future scenarios of climate change while maximizing ecosystem services to the participating communities. Social and economic factors play a key role and concepts of success and growth are examined against a backdrop of change. The case studies emphasize practical examples from diverse farmers' experiences and discuss these against current policies to provide support that translates into workable and scalable applications in the field.

**Talk Title** **VALUING SOCIO-ECONOMIC BENEFITS OF INVESTING IN SUSTAINABLE LAND MANAGEMENT IN THE UPPER TANA RIVER BASIN, KENYA**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Adrian Vogl
Organisation Natural Capital Project, Stanford University
Co-Author(s) Benjamin Bryant; Stacie Wolny; Natural Capital Project, Stanford University | Johannes Hunink; Peter Droogers; FutureWater
Country United States
Abstract Increasing development and degradation of ecosystems means that societies are compromising the ability of forests, wetlands, and other ecosystems to ensure clean water flows. This situation complicates the already substantial challenges facing governments, development agencies, and corporations, who will need to make sizable investments in water infrastructure to keep pace with human needs in the coming decades. The Upper Tana River basin in Kenya is home to 5.3 million people, mostly smallholder farmers, and is a key source of water and hydropower for the 3.2 million residents of Nairobi. In recent decades, large areas of forests and former wetlands have been converted to agriculture, increasing the demand for irrigation water while reducing the natural flow regulation capacity of the watershed. Increasing soil erosion and landslides are reducing soil fertility and causing sedimentation problems in rivers and reservoirs downstream. This combination of factors has motivated the development of the Upper Tana-Nairobi Water Fund, a public-private partnership to safeguard ecosystem service provision and food security. Investing in watershed services is increasingly seen as an integrative approach to sustainable source water for cities, but methods for quantifying impacts of such schemes on both ecosystem services and livelihoods are still in their infancy. In this study, we analyse the impacts of investments in sustainable land use practices on ecosystem services and livelihoods in the Upper Tana basin. We apply an integrated modelling framework, building on local knowledge plus previous field-based and modelling studies, to link biophysical landscape changes at high temporal and spatial resolution to economic benefits for the main actors in the basin. This study is novel in that it presents an integrated analysis for targeting interventions that takes into account stakeholder input, local environmental and socio-economic conditions, and relies on detailed, process-based, biophysical models to demonstrate the economic return on those investments. Finally, in close collaboration with downstream water users, we link those biophysical outputs to monetary metrics, including: reduced water treatment costs, increased hydropower production, and crop yield benefits for upstream farmers in the conservation area. The results help the proposed water fund to understand potential synergies and trade-offs between investments in different conservation activities and locations, and support development of equitable and efficient compensation schemes that address upstream livelihoods as well as benefits for downstream water users.

**Talk Title** **SYSTEMS THINKING AND SUSTAINABILITY MANAGEMENT: A REVIEW OF THE STATE OF THE ART**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Ms Amanda Williams
Organisation RSM, GSB

Co-Author(s) Felix Philipp, Graduate School of Business, University of Cape Town | Steve Kennedy, Erasmus University Rotterdam | Gail Whiteman, Erasmus University Rottderdam
Country South Africa
Abstract Sustainability is complex due to the interconnectedness of social, environmental and economic systems, amplified by dynamic interactions across scales. Numerous scholars have long recognized that sustainability necessitates a systems approach, viewing social systems nested within natural systems and recognizing the dependency of business on nature (Starik & Rand, 1995; Gladwin et al, 1995; Marcus et al. 2010). Understanding how organizations, networks and their natural environment evolve overtime is crucial to progress towards sustainability (Russo & Minto, 2012) and systems thinking provides a new theoretical lens on change processes, which current management theories fail to explain (Plowman et al., 2007). To our surprise, we only found one recent review connecting system thinking and management science (Mingers & White, 2009) and despite the systemic character of sustainability, there has been no comprehensive synthesis how systems thinking has been used to address sustainability challenges. Reviews have focused on traditional management theories such as the resource-based view, competitive strategy, institutional (Bansal & Gao, 2006; Berchicci & King, 2007; Hoffman & Georg, 2012; Russo & Minto, 2012; Etzion, 2007). Whiteman, Walker & Perego (2013, p. 310) criticize the current body of literature on corporate sustainability as being "linearly focused on firm and industry effects, whereas Bansal & Gao (2006) deplore the lack of radical new insights. We address this gap and argue that systems thinking provides a powerful lens to understand management and change across scales for sustainability. We aim to make two contributions. First, we extend the scope to incorporate literature addressing the sustainability of social-ecological systems, as well as examining the micro foundations of sustainability, such as paradigms and values. Second, we take a multidisciplinary approach and consider perspectives from natural and social sciences demonstrating promising avenues for sustainability management research. We followed a systematic review process, including top management -, practitioner - and specialty journals in the period 1990 - 2014. The preliminary analysis indicates a dispersed body of knowledge and an exponential growth in interest, however to date very little representation in top management journals. By conducting review we hope to facilitate the development of the field and to stimulate further reflections and research. Future research specifically ought to address the role of science and educational systems, the role of interdisciplinary work (Kunz et al 2013; Whiteman et al., 2013), issues of power to initiate change (Mahoney et al., 2009) and to integrate the currently loosely coupled approaches and concepts.

**Talk Title** **SHAPING SOCIO-ECOLOGICAL RESILIENCE BY BUILDING THE ADAPTIVE CAPACITY OF LOCAL YOUTH: THE FLOW PROJECT IN BERGRIVIER MUNICIPALITY**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Gina Ziervogel
Organisation University of Cape Town
Co-Author(s) Anna Cowen, John Ziniades, Meshfield Sustainability
Country South Africa
Abstract Social-ecological resilience can be bolstered by increasing local adaptive capacity. In particular, power can shift to local communities when they take more responsibility for their environmental, social and economic wellbeing. This paper reflects on the FLOW Programme (Fostering Local Wellbeing), a transdisciplinary research project based in the Bergrivier Municipality, in the Western Cape. The programme, that has integrated research and practice, aimed to build adaptive capacity of resource poor community members in two towns, strengthen their interaction with the municipality and introduce a community currency to foster local economic wellbeing. We argue that explicitly building adaptive capacity of individuals and communities, particularly in the face of shocks and stress, as experienced through climate change, resource depletion, economic volatility and increasing inequality is a necessary component of addressing socio-ecological resilience. The FLOW programme has worked with youth ambassadors, local entrepreneurs in the formal and informal economy and the local municipality. Interventions have included participatory community mapping, resource flow mapping, quantitative surveys, personal and collective reflective practices, storytelling skills through video journalism and introducing a community currency. The youth ambassadors, who were unemployed before the programme started, have undergone a 9 month leadership programme where they have engaged in many of the project activities. This paper focuses specifically on how the programme has built the youth ambassadors' individual adaptive capacity. Adaptive capacity is dependent on three interdependent dimensions, namely, 1) the development of social cohesion, 2) self-determination, and 3) connection to life-support systems. The analysis of the ambassadors' adaptive capacity draws on questionnaire data, qualitative interviews and narratives from the ambassadors, as well as reflections from the project team and municipal actors. Initial results suggest that the programme has built individual adaptive capacity and has started to shift the governance of the local community to include more frequent interaction with the municipality and increase social cohesion beyond the ambassadors. In conclusion, we reflect on the implications of this programme for transformation where local agency in supported and prioritized among the youth and the business sector and where interaction between different social groups has been enhanced in order to increase socio-ecological resilience.

# SPEED TALK ABSTRACTS

*Listed alphabetically – by Surname*

**Talk Title** **ENHANCING SOCIO-ECOLOGICAL RESILIENCE THROUGH GOVERNANCE: A COGNITIVE –AFFECTIVE BASED INTEGRATIONAL FRAMEWORK IN DIAGNOSING THE ENSUING PHOSPHORUS CRISIS**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Mr Avinash Venkata Adavikolanu
Organisation Centre for Good Governance
Country India
Abstract Governance is a key factor in building socio-ecological resilience. Development of resilience involves the dynamic interplay between the social and ecological systems (Folke et al.,2003) with individuals playing an important role. Previous studies in this field have explained the role of institutional level variables with much depth and clarity. However despite linkages pointing towards the enhancement of socio ecological resilience, the role of individual level variables is crucially missing from this analysis. The role of cognition and affect are yet undermined in the explaining how resilience can be enhanced in socio ecological systems as a result of human actors' actions. This paper seeks to remedy the gap by advancing an integrational framework which intends to overcome the fragmentation of the human decision making system and the institutional level mechanisms by approaching these factors holistically. The example of the ensuing Phosphorus crisis is discussed in light of the framework being advanced. The governance of the Phosphorus crisis is considered important given the limited availability of Phosphorus, its crucial linkages to the biogeochemical planetary boundary (Röckstrom et al.), and more importantly the links to overall food security (Cordell, 2009; Adavikolanu, 2014). To further diagnose the issue, and to draw relevance, a developing country context is offered (India). This is expected to uniquely point out the possible challenges that may emerge and address them by strengthening governance responses to socio-ecological resilience. Additionally the role of these individual level variables in how they can become vehicles of learning in socio-ecological systems is also explored.

**Talk Title** **TECHNOLOGY AND SOCIAL-ECOLOGICAL CHANGE: SCALE MISMATCH, SYNERGY AND CONFLICT IN POOR RURAL COMMUNITIES**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Helene Ahlborg
Organisation Chalmers University of Technology
Co-Author(s) Sverker Molander, Chalmers University of Technology
Country Sweden
Abstract There is little communication and bridging between the research fields of social-ecological and socio-technical systems approaches, while both fields construct systems that share characteristics such as complexity, uncertainty and multi-actor involvement. Beyond that, little conceptual work has been done to understand socio-technical-ecological dynamics. In the real world, however, processes of socio-technical change are at the heart of human use of and relations to natural resources and environments. In this paper we argue that there is need to engage theoretically and empirically with the interfaces between society, technology and nature, to identify how these system conceptions overlap, where and how pressures and feedbacks emerge and what synergies, trade-offs and conflicts that appear as a result of interactions. In this paper, we aim to take the conceptual discussion forward by highlighting where the current discussion may be misleading and by providing an empirical example of how socio-technical change and social-ecological dynamics can be studied and analyzed together. In order to achieve this we draw on socio-technical systems thinking, the concept of scale mismatch and literature on common pool resources (CPR). Our conceptual points are developed using an empirical case study of an NGO-led micro-hydropower development project in Tanzania. The fieldwork took place in 2012-2013 over a period of three months, and multiple data sets were gathered; 142 semi-structured interviews, documentation from participatory observation, group discussions, workshops and documentation (project reports, a GIS study of soil erosion risk, a baseline study of local livelihoods). This case study of a small-scale decentralized energy system problematizes a proposal made recently by some socio-technical scholars: that collective action and CPR theories are relevant to apply in analyses of decentralized energy systems. These attempts at bridging theoretically between fields are valuable. However, the system characteristics are sometimes similar only at the surface, and the application of CPR theory can in some cases be misleading and theoretically flawed, in cases where the technology is poorly understood. Based on our case study and conceptual discussion, we conclude that introduction of a new technology can motivate influential members of a community to engage in natural resource management and environmental protection, also when this generates social conflict and has negative implications for local food security. Theoretically, we conclude that developed understanding of non-human elements, scale and relations of power are critical to advancing the bridging work while keeping complementary analyses genuinely grounded in the theoretical base of each field.

**Talk Title** **CHARISMATIC AND RARE SPECIES MATTER FOR CULTURAL ECOSYSTEM SERVICES**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Ugo Arbieu
Organisation Senckenberg Biodiversity and Climate Research Centre, Frankfurt am Main, Germany. Department of Biological Sciences, Goethe Universität, Frankfurt am Min, Germany.
Co-Author(s) Claudia Grünewald; Matthias Schleuning, Senckenberg Biodiversity and Climate Research Centre, Frankfurt | Katrin Böhning-Gaese, Senckenberg Biodiversity and Climate Research Centre, Frankfurt and Department of Biological Sciences, Goethe Universität, Frankfurt
Country Germany
Abstract Relationships between biodiversity and ecosystem functioning are well known, while those between biodiversity and ecosystem services are much less documented. In particular, the role of biodiversity in providing cultural ecosystem services (CES) has been little studied. Wildlife tourism in protected areas offers a great opportunity to test the relationship between biodiversity and CES. In this study, we counted visitor vehicles and large mammals along 5 km touristic road transects (overall 196 transects) in four protected areas (Etosha, Chobe and Kruger National Parks and Hluhluwe-Imfolozi Game Reserve) in three countries of Southern Africa (Namibia, Botswana and South Africa). We tested the effects of standard biodiversity metrics (species richness, phylogenetic diversity, abundance of large mammals) and of specific subcomponents of biodiversity attractive to wildlife tourists (charismatic, rare and threatened mammal species) on visitor numbers, using generalized linear mixed-models. Our results show that standard biodiversity metrics, specifically species richness, phylogenetic diversity and abundance of mammals, related positively to visitor
numbers along the road transects across the four parks. In addition, subcomponents of biodiversity, such as richness of predators and rare ungulates, were positively associated with visitor numbers, highlighting the importance of charismatic and rare species in providing CES to wildlife tourists. All biodiversity metrics except predator richness and abundance had park-specific effects, showing that biodiversity effects are context-dependent and spatially heterogeneous. In the future, we will deepen our insights into this social-ecological system by assessing mismatches between mammal species' supply and observational demands
from wildlife tourists, derived from tourist interviews in each wildlife park. The exact link between biodiversity and wildlife tourism, as well as the context-dependency of this relationship, is relevant for both the conservation management and the further development and marketing of wildlife tourism in African protected areas.

**Talk Title** **INTERPRETING THE GREEN ECONOMY: EMERGING DISCOURSES AND THEIR CONSIDERATIONS FOR THE GLOBAL SOUTH**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Michelle Audouin
Organisation CSIR
Co-Author(s) Kristy Faccer, UCT (GSB) | Anton Nahman, CSIR
Country South Africa
Abstract Significant global impetus has arisen around the concept of a 'green economy', particularly since its promotion by influential multilateral institutions such as the United Nations Environment Program (UNEP) and the International Labour Organisation (ILO). The concept was first introduced by Pearce et al (1989); however, following the global financial crisis of 2008, the 'green economy' moved into the mainstream of policy discourse. This was evident at the Rio+20 Conference in which it became one of two focus themes. South Africa itself has committed to a transition to a green economy, as articulated, for example in the New Growth Path and its Green Economy Accord (2011). The meaning of the 'green economy', however, has not only expanded in the international debate, but also become increasingly contested (Benson and Greenfield, 2012). In order to navigate this contested terrain, the authors of this paper (published in Development Southern Africa 31 (5), 2014) undertook a literature review and analysis of the trends in the discourse pertaining to the green economy. The intention was to illustrate potential conflicts and highlight underlying assumptions associated with varying interpretations of the concept. These assumptions and potential conflicts have significant implications for governmental policy and planning processes and therefore any transition to a green economy. The authors outlined three stylized, but distinct discourses as follows: the 'incrementalist' discourse; the 'reformist' discourse and the 'transformative' discourse. The paper concludes with a brief discussion on the application of elements of these discourses to southern Africa.

**Talk Title** **BIOFUELS AND BIODIVERSITY: THE ROLE OF TECHNOLOGY AND POTENTIAL IMPACTS ON BIODIVERSITY.**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Ryan Blanchard
Organisation CSIR
Co-Author(s) Dr Patrick O'Farrelll, CSIR | Prof. David Richardson, Stellenbosch University, CIB
Country South Africa
Abstract Globally, a shift towards biofuels aims to reduce our dependence on fossil fuels and to help mitigate the effects of climate change. However, in some developing countries the production of biofuels is closely linked to the need to promote jobs and development in rural areas. The efficiency and viability of biofuels needed to meet these demands are closely linked to the promise of improved technologies in the production and processing of biofuels. Our understanding of biofuels needs to be enhanced to determine uncertainties such as the link between advancing technologies, biodiversity loss and potential trade-

offs between ecosystem services. Ideally biofuel production should not compete with food production. Technological advancement aims to enhance the cultivation of biofuels on marginal land. This may facilitate the conversion of natural land currently not considered as desirable for food production. We test scenarios within a framework which integrates species distribution models, land cover, biodiversity and ecosystem services to identify natural areas with a potentially high risk of transformation to biofuel production. The framework was tested in the Eastern Cape of South Africa, a region which has been earmarked for the cultivation of biofuels. We highlight lessons learnt from this experience to mitigate against potential impacts. Furthermore, we highlight the links between technology, human wellbeing and decisions relating to large-scale transformation of land. This demonstrates a proactive approach for anticipating trade-offs among ecosystem services in various landscapes and provides an objective means of mitigating potential conflict with existing land use and biodiversity.

**Talk Title** **EXPLORING THE CULTURAL SERVICES OF FRESHWATER ECOSYSTEMS IN AN URBAN CONSERVATION AREA**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Mr Gregg Brill
Organisation University of Cape Town
Co-Author(s) Dr Pippin Anderson, University of Cape Town | Dr Patrick O'Farrell, CSIR
Country South Africa
Abstract Current rates of urbanisation and city growth have encouraged research on social-ecological dynamics, specifically our dependence on natural ecosystems for the provision of goods and services in these environments. These investigations are particularly important in sub-Saharan Africa where urbanisation is happening at unprecedented rates. National parks within cities can contribute valuable ecological infrastructure associated with social, economic and cultural dependencies at a broader scale. In particular, the cultural services that are generated within these contexts are poorly understood. This study is focussed on understanding the mechanisms behind cultural services provision in the Table Mountain National Park which is surrounded by the City of Cape Town, South Africa, and examined cultural services associated with freshwater ecosystems and the values ascribed to these by survey respondents. Respondents were active park users, identified by park authorities through their user groups. Two hundred and sixty-five online surveys were completed and responses relating to ecosystem service values were captured across the three sections of the park, in relation to state of the water bodies, as well as accessibility levels. Findings indicate that recreation, and aesthetics and existence cultural ecosystem services are the most highly recognised and valued. Water bodies found in sections closest to where the majority of park users reside were preferred. Features which were more easily accessed had higher visitation rates. Findings demonstrate that a balance between built and green infrastructure is required for a desired diversity of cultural ecosystem service generation and provision, and to mitigate trade-offs between user groups.

**Talk Title** **A SYSTEMS APPROACH TO MANAGING ATMOSPHERIC EMISSIONS**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Mr Roelof Burger
Organisation North-West University
Co-Author(s) Stuart John Piketh, North-West University | Christiaan Pauw, NOVA
Country South Africa
Abstract The atmosphere lies central to most social-ecological systems. However, links to atmospheric processes may be subtle and span spatio-temporal scales seemingly unrelated to a particular problem. Anthropogenic emissions of aerosol and trace gases are key agents in the complex adaptive system that includes energy use, impacts on climate and impacts on health. Air quality in low-income settlements in developing countries like South Africa is extremely poor. Residential solid fuel burning emissions from coal and wood are the primary cause and proves difficult to manage. This paper presents the concept of air-quality-offsets as a strategy to manage anthropogenic atmospheric emissions in the context of social-ecological systems. A case study in a small low-income settlement illustrates the links between poverty, energy use, air quality related health risks, climate change and the environment. A range of interventions to increase thermal insulation were implemented on roughly half of the 1000 houses in the Kwadela settlement on the Mpumalanga Highveld. Measurements before and after the intervention during four field campaigns totaling 12 months included: ambient, indoor and personal exposure to a range of air pollutants, most notably small particulate matter; indoor and ambient temperatures in 20 houses; and agents of climate change. The physical measurements were supplemented with quality of life and detailed energy usage surveys. Results shows a drastic improvement of indoor thermal comfort which translates to a significant reduction in fuel use and exposure to adverse air quality during cold spells. It further demonstrates the delicate interaction between annual household income, residential solid fuel burning and national electricity production. Industry could fund this type of intervention and so offset their own emissions if those do not have adverse effects. This study postulates that a social-ecological systems approach to managing air quality through a vehicle like air-quality-offsets can be beneficial. Traditional command and control strategies fail to protect people living in low-income settlements from adverse health impacts due to indoor and ambient pollution, as well as the surrounding ecosystems from the poor foraging for household fuels. An alternative is to acknowledge the interactions between slow variables, like carbon dioxide, with short term variables, like particulate matter impacting on health, and allow for an overlap in governance. It can stimulate social capital and innovation, ultimately improving the resilience of communities.

**Talk Title** **AN EXPLORATION OF WAYS IN WHICH DANCE MOVEMENT PSYCHOTHERAPY CAN BE USED WITHIN A TRANSDISCIPLINARY WATER MANAGEMENT RESEARCH CONTEXT**

Theme Thresholds, traps and transformations in social-ecological systems.

Presenter Ms Athina Copteros
Organisation Institute for Water Research, Rhodes University
Co-Author(s) Professor Tally Palmer, Dr Vicky Karkou
Country South Africa

Abstract Transdisciplinary (TD) research programs are increasingly being used to respond to complex social-ecological systems. These programs combine different ways of knowing in order to address societal issues that are complex and require multiple strategies needing constant adjustment and adaptation. Working within a TD research team requires the development of skills to cope with difference and to be flexible and reflexive. This research explores how Dance Movement Psychotherapy can contribute to reflexive practice. A group of TD researchers and postgraduate students have met monthly over three years to explore methodologies and approaches that enable a deep and rich exploration of the complex social-ecological systems that comprise people living in catchments (watersheds). In this study eight TD research group participants co-lead each other through a movement-based exploration of the following questions: how to limit the variables of power, privilege and difference in the context of experience of water supply and quality in South African communities; how to maintain lively curiosity and acknowledge one's own racism; how to learn from each other and share practice with a range of disciplines; how to extend healing to the wider community and how to include oral histories and indigenous knowing. This is a new approach to working with social-ecological systems that recognises the significance of body in processes of transformation and interrelationship in order to heal divides and create opportunities for embodied change. Participant researchers learn by engaging in, as well as co-leading, sessions and then apply tools gained to an existing community based project on greater water equity. The process aims to show how a body based creative movement approach can contribute to approaches that seek to align humanity to ecology by aligning mind and body.

**Talk Title** **STAKEHOLDER DIVERSITY OF HEALTH CLINIC GARDENS IN THE BOJANALA DISTRICT (RSA) TO INCREASE RESILIENCE IN A COMPLEX SOCIAL-ECOLOGICAL SYSTEM**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Miss Ancia Cornelius
Organisation North-West University
Co-Author(s) Prof Sarel Stephanus Cilliers , North-West University
Country South Africa

Abstract Nutrition deficiency in chronically ill patients (a crucial problem in South Africa) drives health clinic gardens in the North-West Province to focus on addressing nutrient security by improving their ability to provide essential resources (Vorster et al., 2011). This study aims to identify model clinics with the potential to increase resilience to sustain the community and improve human wellbeing. Resilience is the ability of any system to absorb disturbances and still maintain its functions (Gunderson & Holling, 2001). One objective of this study is to determine the diversity of stakeholders (human capital) involved at each garden as well as their perceptions on ecosystem services provided by the garden. In this social-ecological system, a variety of stakeholders may improve the resilience of the clinic garden because of their role in promoting education and indigenous knowledge, contributing to multiple skills and stimulating leadership in environmental stewardship (Krasny & Tidball, 2009; Peu et al., 2001; Molebatsi et al., 2010; Wills et al., 2009). The social perceptions influence therefore the ecological aspects of the system which will affect the garden management and its ability to provide essential resources to improve human well-being. Tengö et al. (2014) explain that by connecting diverse knowledge systems, new insights and innovations can be obtained about present problems. There are several approaches in which these knowledge systems can be combined to form a synergy such as co-production of knowledge which focuses on both the processes and stages of knowledge generation and simultaneously consider the production of social order (Pohl et al., 2010). The Multiple Evidence Based approach suggested by Tengö et al.(2014) combines indigenous, local, technical and scientific knowledge systems (diversity of stakeholders) to widen the scope and create enriched understanding, a triangulation and joint assessment of knowledge as well as a place of departure for further knowledge generation. A total of 114 clinics were surveyed in the Bojanala District Municipality of the North-West Province. The diversity of stakeholders involved and their perceptions at each clinic garden were determined by means of a questionnaire and compared along an urban-rural gradient and among the different sub-districts of Bojanala. The most common stakeholders involved were groundsmen. An increase of NGO's, private companies and dieticians can be seen in urban settings. In rural areas, community members such as caregivers and traditional health practitioners are more involved. The difference in management of each sub-district influences the combination of stakeholders involved at the clinics. Some sub-districts have more community involvement while others have more involvement from external parties such as private companies and experts.

**Talk Title** **CONSIDERING ONE'S OPTIONS WHEN THE FISH LEAVE: A CASE STUDY OF THE COMMERCIAL HANDLINE FISHERY OF SOUTH AFRICA'S SOUTHERN CAPE**

Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.

Presenter Ms Louise Gammage
Organisation University of Cape Town

Co-Author(s) Charles Mather, Memorial University, St John's, Newfoundland, Canada | Astrid Jarre, Marine Research (MA-RE) Institute and Department of Biological Sciences, University of Cape Town
Country South Africa
Abstract Many pressures make small-scale fishers and communities vulnerable on a variety of fronts. Fishers need to cope with local and global change and require systems that enhance their strategies in order to achieve resilience. The impact and interplay of stressors at multiple scales need to be taken into account in order to understand social-ecological linkages if sustainable livelihoods are to be achieved. There is however, a shortage of appropriately scaled, context-specific data, needed to inform various decision-making processes. This study researched vulnerabilities, coping and adaptation in the small-scale commercial hand line fishery in six communities of South Africa's southern Cape region using semi-structured interviews, available census data and literature. Faced with multi-scalar changes to the broader fishery system, fishers are forced to employ a wide range of strategies to cope with and adapt to change. The variability of adaptation, coping and reaction strategies employed is presented in the place-based context that was found to be important. The fishers' coping and adaptation strategies falls into three main groups. Cognitive and reflexive decision-making processes are shaped by the experience of past and present environments and cannot be understood by the direct impacts of stressors alone. This highlights the need to understand indirect effects and feedback loops in the future. Practical implications of actions are not always the overriding concern in decision-making and underscores the importance of culture and belief systems. The severity of the challenges experienced with policy and a strong resistance to change may exacerbate regulatory processes. The varying levels of resilience displayed by the different communities may be viewed in both a positive and negative light. Whereas one group of fishers have modernised their business strategies and intensified their fishing by going further offshore on larger but economic craft, the second and third group of fishers navigate the status quo because it is "what they know". The second group; characterised by low formal education, poverty and political marginalisation; mostly waits for help from the outside. The wide array of alternative income options displayed by the third group has so far allowed them to make it through hard times whilst always resuming fishing with businesses and strategies remaining largely unchanged. Future research will seek to understand indirect effects and feedback loops better, thereby enhancing our understanding of cross-scale linkages and inform appropriate management strategies that further enhance resilience and adaptation.

**Talk Title FINANCIAL REGULATION AS A SOURCE OF SOCIAL INNOVATION: A REGULATION 28 CASE STUDY**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Ms Alison Goldstuck
Organisation Global Green Growth Institute
Co-Author(s) Dr Stephanie Giamporcaro, Research Directo, UCT Business School | Malcolm Gray, Investec Asset Management
Country South Africa
Abstract Regulation 28 of the Pension Funds Act obligates pension funds to consider the effect of environmental and social (E&S) factors on an investment's risk-adjusted return, as part of their fiduciary duty, both before and while being invested in an asset. Effectively it mandates investors to acknowledge the interrelationship between strong ecological-social systems and a resilient economy, which is a starting point towards better stewardship. Results from over twenty semi-structured interviews indicate when non-financial risks are recognised investors gain a systemic appreciation of risk, have a longer investment time horizon and invest in a broader universe of assets. Subsequently, the value of the goods and services produced by social-ecological systems are monetarised, increasing investment in companies whose core business practices preserve and build social-ecological capital. Regulation 28 is referred to as 'light touch regulation' because it is principle-based and relies heavily on a voluntary market-based oversight mechanism (i.e the market self-regulates). The paper assumes that the investment approach outlined in the preamble and principles of Regulation 28 (referred to as the E&S investing) and complementary sustainable investment codes have created a strong regulatory-policy governance framework for sustainable investment. Hence, the paper's research question is how to activate the implementation of this framework. Considering the design of the South African approach, answering the research question requires understanding the industry's dynamics and identifying incentives to change these dynamics. A systems perspective is applied to trace the economic, social, cultural (i.e. values and worldview) and political issues informing the creation, negotiation and acceptance of Regulation 28. Lessons from this experience are synthesised to understand how creative stress can be used to increase the number of pension funds implementing E&S investing comprehensively and consistently across all asset classes. Even though research findings suggest multiple tipping points are needed to reform the investment system, active asset owners can play a catalytic role in creating initial momentum for sustainable investing. Principle-agent relationship theory is applied to explore how passive asset owners can become more active in holding their service providers accountable for implementing E&S investing. However, increasing demand is insufficient. Service providers also need to accept that E&S investing is integral to their business' resilience and not an additional activity. Case studies of innovative investors' business architecture, process and products are highlighted to show that integrating E&S risk analysis into investment decision-making improves pension fund governance and the management of risk.

**Talk Title DEVELOPING SOCIOECOLOGICAL SCENARIOS BEYOND GDP GROWTH**
Theme Thresholds, traps and transformations in social-ecological systems.
Presenter Dr Ulrika Gunnarsson-Östling
Organisation KTH - Royal Institute of Technology
Co-Author(s) Åsa Svenfelt, Eléonore Elfström Fauré , KTH - Royal Institute of Technology

Country Sweden
Abstract This paper describes the development of scenarios for developments beyond traditional GDP growth, within the field of planning and building. The aim is to show how backcasting scenarios fulfilling important and far-reaching socio-ecological targets can be related to a steady-state or de-growing economy. Thus, the scenarios can contribute to a discussion on how society can enhance its capacity to adapt to periods when GDP growth halts, but also to understand the consequences of de-growth as a sustainability strategy. Having preparedness and tools for how to cope with declining growth is deemed to be of highest societal relevance, irrespective of whether this is regarded as a possibility or as a threat.In policies for sustainable urban development, continued GDP growth is generally taken for granted. Sustainable growth is an overall political goal, however the rhetoric around this concept has become increasingly criticized by researchers pointing to that there is no evidence of nations having decoupled growth from environmental degradation, given that the global footprints of these nations are accounted for. Besides, GDP growth is still reliant on access to cheap energy, and in the context of climate change and peaking resources, it is predicted that energy costs will rise. This study takes a backcasting approach and the scenarios developed are target-fulfilling multicriteria scenarios. This means that they do not seek to answer the question "what will happen?", but instead describe futures where important socio-ecological sustainability targets are fulfilled. They consist of one target for reducing climate impact, one for sustainable and equitable land use, one for a fair distribution of power, influence and participation in society and one for welfare/resource security. All targets take social-ecological systems as a starting point which means that social and ecological systems are seen as interlinked. The business as usual target of continued GDP growth might be a kind of trap that pushes social-ecological systems towards an undesirable future. Since incremental change might not be sufficient to break out of the trap, backcasting scenarios describing radically different futures can create the basis for discussions on actions needed.The main focus of the paper is to describe the transdisciplinary development of four target-fulfilling scenarios. All scenarios fulfill the same targets, but the scenarios build on different interpretations of justice and ideas for transition. One builds on the leading idea of a circular economy in the welfare state, one on sustainable automatization, one on local self-sufficiency and lastly one on collaborative economy.

**Talk Title MODERNIZING PROTECTED AREAS CONCEPT FOR MULTIPLE BENEFICIARIES**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Nyeema Harris
Organisation WWF International- Luc Hoffmann Institute
Co-Author(s) David Gill, Louise Gallagher , Sesync, Luc Hoffmann Institute
Country Switzerland
Abstract The incessant requirements of a growing human population for both space and resources threaten the sustainability of "fortress conservation" schema such as protected areas. So, despite over a century of implementation with over 160 000 individual protected areas and global declarations of expansion, their value remains under scrutiny. The apparent dichotomy in protected areas delivering conservation goals versus social agendas could simply be a case of miscommunication in how protected areas are casted in a broader context for human benefit. The modern movement in conservation recognizes protected areas as socio-ecological systems, increasingly progressing from iconic landscapes and species as the justification for establishment to an ecosystem services framework. However, it's unclear whether tools presently in practice to monitor performance fully integrate the suite of ecological and social benefits possibly derived from protected areas. Here, we review over 100 tools used to assess performances of places including those explicated designed for marine and terrestrial protected areas. We categorized the indicators within the tools into three domains: social (e.g., human well-being, access and cooperation); ecological (e.g., biodiversity, habitat quality and ecosystem services); and economical (e.g., fines, tourism, employment). We found that most tools aimed at evaluating management effectiveness, but these were insufficient at assessing outcome variables relevant for conservation goals or economic development. Furthermore, ecological indicators were dominant though those pertaining to ecosystem services were confounded by issues related to access, legal use, and rights. This finding highlights the need for improved evaluation of social benefits derived from protected areas. Ultimately, the goals of protected areas must delivery conservation outcomes that are reflected in the maintenance of biodiversity as well as ecological processes and services as a public good.

**Talk Title DEALING WITH THE CHALLENGE OF MEASURING IMPACT OF COLLABORATIONS FOR SOCIO-ECOLOGICAL SYSTEMS CHANGE**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Miss Katre Leino
Organisation Vlerick Business School
Country Belgium
Abstract OBJECTIVEThis paper is based on ethnographic research at an international NGO. The NGO has an established role and ambition to facilitate change for sustainability through collaborative multi-stakeholder platforms (MSPs). A key challenge emerging from the inductive research for facilitating change across socio-ecological systems (SESs) is the significance of measuring the impact of the collaborative projects that the NGO is facilitating. This paper will discuss the importance of being able to measure the outcomes of collaborative MSPs for sustainability, and how organisations deal with this challenge in situations where there is necessarily no clear cause-effect relationship between project participation and impact observed.BACKGROUNDPrevious literature has suggested that in order to develop effective solutions for complex problems, a wide range of stakeholders affected by the issue or the potential solution should be involved. Many of the

sustainability-related problems the world is facing today can be seen as wicked problems or grand challenges spanning different levels of the natural, social and economic systems. Thus, the aim is to gain the involvement of a number of stakeholders, including NGOs, companies, governments, research institutes and citizen groups affected by the issue. However, while some stakeholders are happy to participate in the projects for the sake of participating, other stakeholders need demonstrable outcomes in order to justify their continued involvement in it. The resources invested can be in the shape of time, finances or information that they have invested. Not being able to demonstrate a "return on investment" can cause certain stakeholders to withdraw from participating in the project, thus negatively affecting the MSP and its reach in the SES. Measuring outcomes of these projects, however, is challenging, as sustainability solutions are often not easily quantifiable into conventional metrics used by organisations. Furthermore, solutions for environmental issues often only start to reveal their true impact after several years. METHODS The paper is based on an ethnography involving multiple MSPs on sustainability issues. The methods include participant observation at the organisation as well as the platform workshops, and interviews with the employees of the NGO as well as the participants of the MSPs. The emerging data is analysed using NVivo. RESULTS The results will outline some of the techniques that have emerged during data collection, which are used by the NGO as well as external participants to deal with the challenge of measuring impact of collaborative projects in the context of change for SES. CONCLUSIONS The insights presented will be relevant for academics, practitioners as well as policy makers who are dealing with the challenge of measuring the impact of collaborative projects while hoping to speed up the rate of sustainable development and change in SESs.

**Talk Title** **BUSH ENCROACHMENT AS A REGIME SHIFT: A REVIEW OF KEY FEEDBACKS, DRIVERS AND IMPACTS**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Miss Linda Luvuno
Organisation Stellenbosch University
Co-Author(s) Reinette Biggs, Stockholm Resilience Centre, Stockholm University | Karen Esler, Conservation Ecology and Entomology, Stellenbosch University
Country South Africa
Abstract Many grasslands and savannas around the world are affected by bush encroachment, the replacement of a productive grass layer by a woody layer. Open savannas are vital ecosystems that support a range of livelihoods, economic activities and biodiversity. Bush encroachment threatens the provision of food and clean water, grazing for cattle ranching, and some of the world's last remaining mega-herbivores. It therefore has significant economic, cultural and ecological implications, and this shift in vegetation structure is often unexpected and difficult to reverse. This suggests that it is maintained by positive feedback loops that link the vegetation and social-ecological variables such as fire, grazing and resource availability. Much of the work done on bush encroachment has focused on the drivers of the process – such as the role on fire or grazing in inhibiting or promoting the process, but little work has been done on how ecological changes may feedback to effect some of the social processes driving encroachment, and how this may in turn impact on ecosystem services and human well-being. This presentation presents a qualitative systems model of bush encroachment based on the literature that provides an expanded way of understanding bush encroachment as a social-ecological regime shift rather than an ecological shift, as is mainly presented in the literature. We also provide a literature-based synthesis of the impacts of bush encroachment on ecosystem services and human well-being. Based on this systems analysis of bush encroachment we identify potential social and ecological leverage points – places to intervene in the system – to prevent or reverse the bush encroachment process.

**Talk Title** **MULTI-SCALE DRIVERS, IMPACTS AND RESPONSES OF LAND USE CHANGE ON SOUTHERN AFRICAN WATER RESOURCES**
Theme Cross-scale connections and feedbacks that impact structure and dynamics of social-ecological systems.
Presenter Mr Simphiwe Ngcobo
Organisation University of KwaZulu-Natal
Country South Africa
Abstract It is now beyond debate that human activities are altering all major Earth System compartments and processes in ways never before imagined with equally unprecedented impacts, both currently and in the future. Current escalation in local and global demand for natural resources and the intensive socio-economic development agendas currently being adopted throughout Southern Africa are prompting rapid land use change (LUC) across the region. However, there is limited understanding of the regional drivers and potential impacts of LUC - primarily aimed at establishing and sustaining sugarcane production systems - on water resources at appropriate spatial and temporal scales. Water resource depletion and degradation and potential ecosystem destruction are all issues which raise concern regarding the expansion of sugarcane production considering the highly variable hydroclimatic environment characteristic of this region. The impacts of sugarcane production on the resilience, response diversity and sustainability of water resources and socio-economic systems remain virtually unknown. The proposed study, therefore, aims to investigate the impacts of sugarcane production on the sustainability, continuity and integrity of water resource systems and socio-economic development at appropriate spatial and temporal scales across Southern Africa. To achieve that aim, this study will a) make use of the dynamic, physically-based, multi-scale hydrological models ACRU and the Lund-Potsdam-Jena managed Land (LPJmL) Model to empirically demonstrate the impacts of sugarcane on streamflow at specific catchments across Southern Africa, b) use the impact-modelling results from (a) to produce sustainability indices to highlight the impacts of sugarcane production on the sustainability of water resources and socio-economic development, and c) investigate and detail the responses and feedbacks engendered by multi-scale vertical

and horizontal system integration specifically stemming from sugarcane production. The study will be conducted at both Quarternary (local) and Primary Catchment scales and will include the Mngeni Catchment in South Africa, the Kilombero Catchment in Zambia and the Ubombo Catchment in Swaziland, and will consider short- (2015-2020) and long-term (2020-2099) temporal scales. It is believed that effective environmental management in a rapidly changing region will increasingly rely on a novel, detailed and empirical understanding of the key role of water in sustaining socio-economic systems across a wide range of spatial and temporal scales. Studies such as this one, aim to effectively understand the responses and feedbacks between anthropogenic land use change, water and society and contribute meaningfully towards the goal of global environmental sustainability.

**Talk Title** **LAND USE CHANGE IN LEPCHA INDIGENOUS VILLAGES IN THE SIKKIM HIMALAYAS: A HISTORICAL ETHNO-ECOLOGY APPROACH**

Theme Thresholds, traps and transformations in social-ecological systems.

Presenter Ms Saori Ogura
Organisation UC Berkeley
Country United States

Abstract The indigenous Lepcha people have lived in Sikkim, a world biodiversity-hotspot, for more than eight centuries. Their traditional agricultural practices, hunting and gathering, enabled them to be self-sustaining in the biodiverse forest. Cultivated agriculture began around 1900 with the introduction of wet rice and cardamom. In the 1970s, the cultivation of commercial cardamom expanded, but collapsed in 2000 due to disease.

This research used both qualitative and quantitative methods to understand their relationships with the natural environment, how they have changed due to outside contact with the global economic system, and the components of age-old and quickly disappearing indigenous livelihood strategies. This involves case studies at three scales on land use changes in the Lepcha territory following the expansion of cardamom. The first is a coarse-grained GIS study of land use change for the village from 1989 to 2012. The other two are fine-grained key-informant interview studies—one on land use change, and the second on the persistence of traditional food crops.

Using spatial analysis and on-the-ground observation and interviews, I found a decline in crop diversity in the area devoted to the monocultural cardamom cash crop system, which is cultivated in the forest understory. After the cardamom crop failure, the forest cover increased. The decline of the agricultural area is due to the shift to a cash economy. Villagers are farming less and depending more on government subsidies and government jobs. With increased consumption of rice from the market, there is a loss of diversity in local seeds and varieties in the staple diet. Traditional cultivated food crops have persisted, for the most part, only in the most remote villages.

This study documented 36 traditional food plants, including 16 traditional cultivated crops and 20 gathered plants, representing 14 different plant families. Few of them are found as global species, and 32 of the 36 plants are regional species only. Those plants, especially certain millet and rice varieties appear to be at risk and could soon be lost. While the research identifying these food plants was a first step towards saving them and supporting healthy local diets, further research could be undertaken to identify strategies of using the food plants to help communities become more stable and resilient in the face of the fluctuations of the global economic system and climate change.

**Talk Title** **A NOVEL CLIMATE-WATER CONFLICT VULNERABILITY INDEX TO CAPTURE DOUBLE EXPOSURE IN SOCIO-ECOLOGICAL SYSTEMS: APPLICATION IN THE SOUTH-EASTERN SHORES OF THE LAKE CHAD BASIN IN CHAD REPUBLIC**

Theme Thresholds, traps and transformations in social-ecological systems.

Presenter Dr Uche Okpara
Organisation University of Nigeria
Country Nicaragua

Abstract Highlights 1. I present a systematic methodology to operationalise livelihood vulnerability to climate change and water conflict2. The approach is place-based, bottom-up and puts different resource user groups directly at the centre of analysis3. Pastoralists tend to be more vulnerable in terms of climate-induced aggressive behaviour/struggles over water4. A silver bullet for double exposure is not apparent but locally-appropriate guidance can be provided through the information indicators communicate. AbstractClimate change is among the array of vexing threats facing agricultural livelihoods around the world, although its effects are not evenly distributed. With resource conflict looming ever larger as one significant outcome of climate change, understanding the underlying drivers that shape differential vulnerabilities in areas that are double-exposed to climate and conflict therefore has great significance. Climate change vulnerability frameworks are rarely applied in water conflict research, so this article presents a composite Climate-Water Conflict Vulnerability Index (CWCVI) based on a double exposure framework developed from key advances in vulnerability and livelihoods assessments. I apply the index to tease out whether and how the determinants of vulnerability can be useful in understanding climate and water conflict interactions and to establish how knowledge of the climate-conflict linked context in which vulnerability is experienced can help shape interventions to reduce vulnerability. I surveyed 240 households in 7 villages at the south-eastern shores of Lake Chad in Chad Republic to collect data on a range of exposure, sensitivity and adaptive capacity variables. Results suggest that pastoralists are more vulnerable in terms of climate-structured aggressive behaviour within a lake-based livelihoods context where all resource user groups show similar levels of vulnerability to climate variability. The CWCVI approach can be used to understand the human and environmental security components of vulnerability to climate variability

and change, and to explore ways in which conflict-structured adaptation (i.e. climate-adaptation that is conflict-proof; that does not pitch one resource user against another in a context where people are constantly pursuing similar resources at the same time) and climate-sensitive conflict management strategies may be integrated to enhance the resilience of vulnerable populations in high-risk, conflict-prone environments.

**Talk Title** **COOKSTOVE ADOPTION: THE DYNAMIC INTERPLAY AMONG CULTURE, ENERGY AND TECHNOLOGY IN A SOCIO-ECOTECHNOLOGICAL SYSTEM**

Theme Thresholds, traps and transformations in social-ecological systems.

Presenter Prof Ilse Ruiz-Mercado
Organisation Universidad Nacional Autonoma de Mexico - IIES
Co-Author(s) Omar Masera; Pablo Venegas Garcia; Sergio L. Guzman; Edgar S. Garcia Treviño; Myriam A. Miranda Gamboa; Universidad Nacional Autonoma de Mexico
Country Mexico

Abstract Improved cookstoves and clean fuels have long been identified as promising options to reduce the negative impacts of cooking with traditional open fires and the emission of climate-altering pollutants, while meeting goals of social welfare and increased environmental sustainability. However, no stove program can achieve these goals unless people initially accept the stoves, continue using them on a long-term basis and displace the smoke of the traditional fires. The adoption of clean cookstoves and fuels is one of the transformation processes occurring at the technological interface of socio-ecological systems. Monitoring the drivers, thresholds and critical times of this process is critical to translate implementation efforts into impacts, and to understand the feedbacks between household-level and ecosystem dynamics introduced by these technologies. The aim of this project was to measure stove usage and characterize the adoption and fuelwood consumption patterns to improve monitoring and implementation strategies. The analysis draws from a literature review of studies in several countries documenting that introduction of a single improved stove/fuel often leads to the combination or "stacking" of stoves and fires rather than to complete substitution. We also draw field evidence from a study we carried out in rural Mexico where the stoves and fires of 100 homes in three communities were instrumented during one year with small temperature dataloggers as Stove Use Monitors (SUMs) to obtain cooking durations and number of days and meals in use using custom software tools for data mining. In two communities, we also measured fuel consumption and document fuelwood access rules with household surveys. Based on the SUMS-measured patterns of combined stove-fire use, we classified households into clusters. Stacking occurred because traditional fires fulfill needs that extend beyond cooking. Measured residual use of open fires in households using improved and/or LPG stoves was 1.8-3.9 hours/day, representing a contribution that can still have important negative health effects, depending on the time–location patterns of use. Families with improved cookstoves reported collecting wood of smaller sizes and had 37-50% less fuelwood consumption than those with open fires, but fuelwood access rules were the same for all clusters at the time of surveys. We conclude that complete realization of benefits of clean cookstoves require projects to promote a portfolio of fuels-stoves-practices rather than a single technological solution. Our study shows the usefulness of sensor-based measurements and the critical need for long-term monitoring studies of ecotechnology adoption processes to better capture their ecosystem feedbacks.

**Talk Title** **ECOSYSTEM SERVICE TRADEOFFS AND ECOLOGICAL-ECONOMIC PRODUCTION POSSIBILITIES FRONTIER: A CASE STUDY IN COSTA RICA**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Ms Améline Vallet
Organisation Agroparistech
Co-Author(s) Bruno Locatelli, CIRAD-CIFOR | Harold Levrel, AgroParisTech-CIRED
Country France

Abstract Understanding interactions between ecosystem services (ES) is a high priority in ES research. Two types of interaction are commonly defined: (1) tradeoffs, in which one service increases while another one decreases in time or space; (2) synergies, in which both services either increase or decrease. Most studies on ES use statistical analysis and descriptive methods to assess ES spatial or temporal correlation. Recently, a new framework for ES interactions based on ecological-economic production possibilities frontier (EEPPF) has been developed, which relies on the production theory branch of microeconomics. Applied to natural capital, this framework considers different levels of ES produced across a broad range of management actions and landscape configurations and describes graphically the nature and intensity of ES interactions by determining the production frontier (i.e. the set of Pareto-optimal values for pairs of ES). This study aims to estimate empirically EEPPF between multiple ES in the Volcanica Central-Talamanca Biological Corridor, Costa Rica, and to discuss the EEPPF framework complementarity with statistical approaches. InVEST software was used to model ES production for carbon storage (C), water yield, sediment retention, nitrogen retention (n) and phosphorus retention (p). Agricultural production (pa) was represented by its economic value. Spatial concordance and temporal covariation between ES were analyzed using statistical correlations (modified t-test) for four observed land-uses (LU) over time. EEPPF curves were constructed using a set of 32 contrasting LU scenarios generated, considering slope and altitude constraints for some LU and assuming different LU proportions and distributions (either random or clustered). EEPPF analysis showed tradeoffs between C and other ES, and between pa and nutrient retention (n and p). The shape of EEPPF curves illustrated the intensity of tradeoffs. The nature and intensity of interactions between C and other ES varied widely according to the methodologies used for evaluating tradeoffs. In comparison with the analysis of spatial and temporal ES correlations, EEPPF

curves brought supplementary information related to tradeoff intensity and identification of optimal LU scenarios.

**Talk Title** **SOCIAL ECOLOGICAL INTERACTIONS OF INLAND RECREATIONAL FISHERIES WITH INCREASED LAKESHORE DEVELOPMENT**

Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

Presenter Mr Jacob Ziegler
Organisation McGill
Co-Author(s) Stuart Jones, Department of Biological Sciences, Notre Dame University | Brian Weidel, United States Geological Survey | Christopher Solomon, Department of Natural Resource Sciences, McGill University
Country Canada

Abstract Background: Humans are the principal drivers of ecological systems on the planet, yet we lack a basic understanding of how humans are integrated into food webs and how this affects management of natural resources. Recreational fisheries, which are socially and economically important worldwide, are vulnerable to both social and ecological forcing. For example, in North America residential development on lakes reduces available refuge for juvenile fish, increases angling pressure, and increases the likelihood of stocking due to public pressure on fisheries managers. Objectives: We wanted to explore the outcomes of codependent social and ecological pressures on recreational fisheries by examining the interaction between lakeshore development and a common management panacea of stocking. Methods: We created an integrative model with biological, social, and habitat sub models that characterized key components of the socio-ecological system. We tested our model output using empirical data from 61 lakes in northern Wisconsin, USA. Results: Our model and empirical results suggest that loss of habitat associated with residential development on lakes led to decreased angler satisfaction and an increased reliance on stocking of hatchery raised fish in these systems. From an economic point of view, systems that had high lakeshore residential development and stocking rates cost lake users and government agencies more money than tax revenue generated, whereas, systems with low lakeshore residential development and low stocking rates were profitable systems that maintained the ecosystem service of recreational fisheries. Conclusions: These results highlight the importance of considering social and ecological factors in management decisions to create more resilient systems.

# POSTER ABSTRACTS

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**Talk Title** **PRINCIPLES FOR BUILDING RESILIENCE: SUSTAINING ECOSYSTEM SERVICES IN SOCIAL-ECOLOGICAL SYSTEMS**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Dr Reinette Biggs
Organisation Stockholm Resilience Centre
Co-Author(s) Maja Schluter, Stockholm Resilience Centre | Michael Schoon, Arizona State University
Country Sweden
Abstract As society and the world we live in face increasingly rapid and turbulent changes, the concept of resilience has become an active and important research area within the emerging field of sustainability science. Over the past two decades there has been an explosion of research into system attributes that may promote or undermine the resilience of ecological, social, and coupled social-ecological systems, and the ecosystem services (e.g. freshwater, climate regulation) on which society depends. Given the diversity of potential attributes involved, this has stimulated research that draws on a wide range of disciplines, including social, economic, political and ecological sciences. However, it has also led to a somewhat dispersed and fragmented understanding of the importance of different resilience-enhancing factors such as diversity, learning or polycentricity, and the empirical evidence in support of these factors. This poster provides highlights of a new synthetic book led by the Resilience Alliance Young Scientists (RAYS) that aims to systematically assess and evaluate the empirical evidence in support of 7 broad principles for enhancing the capacity of social-ecological systems to continue delivering desired sets of ecosystem services: (1) maintain diversity and redundancy, (2) manage connectivity, (3) manage slow variables and feedbacks, (4) foster an understanding of SES as complex adaptive systems, (5) encourage learning and experimentation, (6) broaden participation, and (7) promote polycentric governance systems. The book brings together and synthesizes different strands of resilience research, specifically in relation to the evidence and implications of this work for managing social-ecological systems.

**Talk Title** **THE SOUTHERN AFRICAN PROGRAM ON ECOSYSTEM CHANGE AND SOCIETY (SAPECS): SUPPORTING SOCIAL-ECOLOGICAL STEWARDSHIP AND FINDING PATHWAYS OUT OF POVERTY**
Theme Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.
Presenter Dr Reinette Biggs
Organisation Stockholm Resilience Centre
Co-Author(s) Belinda Reyers; Maike Hamann; Stockholm Resilience Centre | Georgina Cundill, Rhodes University | Dirk Roux, SANPARKS and Nelson Mandela Metropolitan University | Graeme Cumming, University of Cape Town | Jeanne Nel, CSIR
Country South Africa
Abstract A defining challenge of the 21st century is to find new pathways for large-scale societal transformation out of poverty that do not undermine the ecosystem services on which human well-being depends. This challenge is particularly acute in sub-Saharan Africa, where many people still live below the poverty line. The Southern African Program on Ecosystem Change and Society (SAPECS) is a transdisciplinary research program that aims to advance stewardship of social-ecological systems and ecosystem services in southern Africa. SAPECS is linked to the international Program on Ecosystem Change and Society (PECS), a 10-year research initiative within the ICSU global change programs, and is the local host for the first PECS international conference. SAPECS functions as a network or community of practice comprising about 30 researchers from within the southern African region and abroad actively engaged in researching social-ecological in a range of case studies and projects at various scales in southern Africa. SAPECS is structured around various cross-cutting working groups that aim to facilitate cross-cutting comparative studies and syntheses that draw on in-depth social-ecological case studies around the region. This poster briefly introduces SAPECS, highlighting some of the emerging insights in relation to the six core themes of SAPECS: 1. How changes in social-ecological systems (SES) and ecosystem services influence human well-being and equity, with an emphasis on poverty and inequality 2. How the dynamics of SES in southern African are shaped by structures and processes at interconnected local, regional and global scales, as well as over a range of timescales 3. How governance and management institutions and practices affect SES, including the capacity for learning and transformation 4. Potential traps and transformations in the structure and dynamics of SES, and the consequences of different development trajectories 5. How knowledge can be mainstreamed into policy and practice to achieve tangible impact and effect change in SES governance 6. How transdisciplinary, collaborative approaches can be best applied, including transdisciplinary graduate training.

**Talk Title** **AGROFORESTRY SYSTEMS IN PERNAMBUCO STATE, SEMIARID OF BRAZIL: CLIMATE CHANGE ADAPTATION AND FIGHT AGAINST DESERTIFICATION**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Dr André Gonçalves
Organisation Instituto Federal Catarinense
Co-Author(s) Simone Carolina Bauch, Interamerican Development Bank – IADB | Ilyas Siddique, Universidade Federal de Santa Catarina | Lúcio de Paula Amaral, Universidade Federal de Santa Maria

Country Brazil

Abstract Objective. To conduct a prospective study to evaluate the feasibility of agroforestry systems (AFS) implemented by smallholders in producing ecosystem services and combating desertification. Secondary objective was to develop and test a participatory methodology to assess the resilience of agricultural systems. Background. Climate change projections indicate that the semiarid region of Brazil situated in the northeast of the country will be particularly affected. Less rainfall and higher temperatures causing increased evaporation will accelerate the desertification process that is presently taking place. Such process will bring severe consequences for agricultural activities and jeopardize the Caatinga, an exclusive Brazilian biome. The semiarid region concentrates 58% of the poor in the country, and poverty directly affects 67.4% of youngsters. In Pernambuco state approximately 73% of its municipalities are in areas susceptible to desertification. Some agricultural methods proposed as a strategy for coexistence with semiarid conditions and simultaneously combat desertification are based on agroforestry systems (AFS). A regional influential non-governmental organization (NGO) named Instituto Sabiá has been proposing such systems as a viable alternative to produce food and generate income for poor farmers. Empirical evidences demonstrate that these systems can combat desertification and are more adapted to a context of climate uncertainties. Method. To build a conjunction of resilience indicators a workshop was conduced where farmers, rural extension workers, and other agricultural leaders participated. Initially some basic theoretical concepts such as ecosystem services, resilience and social-ecological systems were discussed, and participants were asked to indicate the main resilience indicators. As a result, a questionnaire containing 29 questions was elaborated. A group of 15 farmers were selected to answer the questionnaire. For carbon sequestration and biodiversity analysis 38 plots of 700 m2 were installed in in 14 different farmers` areas. Phytosociological analyses were performed and biomass was estimated through allometric equations. Results. AFS can store up to 40 tons/ha of CO2 eq in a 12 years period. Some systems have a significant number of endemic tree species, which suggests an important role in biodiversity conservation. Strategies to store water are particularly important to provide means to live in a situation of draught. Most of the farmers have different marketing strategies for their products, suggesting a way to guarantee economic resilience. Conclusion: AFS as a land-use strategy in the semiarid region can play an important role, especially for poor families. These systems can combine food production, income for farmers, and a range of ecosystem services. It can also contribute in combating desertification.

**Talk Title THE SOCIO-ECOLOGICAL DYNAMICS AND TRADE-OFFS IN UNDERSTANDING A WILDERNESS EXPERIENCE IN KRUGER NATIONAL PARK**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Marna Herbst
Organisation SANParks
Country South Africa

Abstract Wilderness trails are a unique tourism activity in the Kruger National Park and provides the opportunity for guests to experience an exclusive, tranquil and remote experience in the African bush. This specific activity focuses more on the experience than the wildlife sightings itself and promises a more sensual experience that will bring tourists closer to their natural surroundings than just visually driving in the park. Understanding tourists' expectations and experiences are important for managers to evaluate their tourism product offerings. The financial viability of this activity remains a concern for tourism managers. From a management perspective there are several ideas and suggestions on how to improve the tourism activity. However these ideas have different trade-offs and it is important to understand the linkages between these trade-offs and how they will influence the tourism experience and the quality and expectations of the product. This survey aims to conduct in-depth personal interviews with guests to determine their view of a wilderness trail experience and if these expectations were met. The survey will also include short interviews with tourism managers and trails rangers on their experiences and interactions with guests and what they perceive to be the most important qualities of the product offering. Results will be discussed in terms of how different role players perceive a wilderness experience and how different expectations with underlying trade-offs can be met. It is anticipated to present a systems diagram, indicating the linkages and trade-offs in a visual way for interpretation as a practical tool for discussion to tourism managers.

**Talk Title ASSESSING CHANGES IN THE WETLANDS' ECOSYSTEM SERVICES IN THE PERI-URBAN ENVIRONMENTS, JOHANNESBURG, SOUTH AFRICA**

Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.

Presenter Dr Thabiso Mokotjomela
Organisation University of Witwatersrand
Co-Author(s) Furniss, D.G, Knight, J, Mharakurwa, S.
Country South Africa

Abstract Wetlands ecosystem services are increasingly being lost due to escalating conservation threats under global change. However, limited number of studies have quantified rate of change in the ability of the wetlands to elicit ecosystems goods and services in a socio-ecological context. This knowledge is critical for context-based conservation and sustainable use of the wetlands through promotion of stewardship. Using geographic information systems and remote sensing tools, we conduct a time series analyses of the structural changes imparted by anthropogenic effects over the past 20, 15, 10 and 5 year time-intervals for two wetlands, one located in the peri-urban, and the other in protected areas of Johannesburg. Dated images of the two wetlands are downloaded using Landsat 8, and are being analysed. Ethnographic surveys (i.e. interviews, observation and participation approaches) are also applied to discern how observed changes in the wetlands have affected human

benefits (i.e. provisioning, supporting, regulating and cultural roles) and how these changes are perceived. Preliminary results suggest that human pressure through pollution and conversion of wetlands to farming land deteriorate the natural health of the wetlands, and thus reduce quality of services provided to community. The conservation implications of the results for the studied wetlands will be discussed and recommendations provided.

**Talk Title** **SOCIOECONOMIC IMPACT OF MARINE INVERTEBRATES COLLECTION ON CHUIBA AND MARINGANHA BEACHES.**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Mr Siran Offman
Organisation Marine and Coastal Environment Research Center (CEPAM)
Co-Author(s) Hermes Pacule, Marine and Coastal Environment Research Center (CEPAM)
Country Mozambique
Abstract Marine invertebrates are very important for livelihood of coastal communities particularly in Pemba city The study was conducted From June 2011 to March 2012. The objective of this study is to determine the socioeconomic impact of collecting marine invertebrates in communities and Chuiba Maringanha. Data were collected biweekly during the spring tide ebb in the intertidal zone and through structured surveys the confrontation of data was done through direct observation in the neighborhoods. In total 40 collectors was surveyed and it was found that activity of collecting marine invertebrates is practiced by women 57.2% and men 42.5%. Their ages ranged from 9 to 45 years and the range was 25-32 dominant with 30.5% and collection practice 5-7 times per week they spend about 4-6 hours a day. The collection methods are direct harvesting by hand aided by knives, sharp irons and transport use pots, buckets, basins, shawls. Were identified in total 8 marketable species namely: Octopus vulgaris 8.6 Kg, Cyprea Tigers 7 units, Cypraea annulus 48 kg, 40 kg holuturias, Cyprea bully, Atrina vexilium 10 kg, Modiulus philiphinarum and lambis lambis. The species with the greatest economic value are sea cucumber (100.00 Mts / kg) and Octopus vulgaris (80 Mts / kg) more commercialized. The socio-economic impacts on communities of collectors the average income of collectors varies from 15 to 150.00 Mts/ day and the money is intended to purchase food and agricultural instruments. The other socioeconomics impacts are illiteracy with 36% dropout and 28% have never studied 87% of unemployed collectors, high number of family members, weak economic power, poor housing made the basis of local materials, and relies on community wells to access water and most do not have electric power.

**Talk Title** **THE REGIME SHIFTS DATABASE: A GLOBAL COMPARSION OF DRIVERS AND ECOSYSTEM SERVICE IMPACTS OF REGIME SHIFTS**
Theme Thresholds, traps and transformations in social-ecological systems.
Presenter Dr Juan Rocha
Organisation Stockholm Resilience Centre
Co-Author(s) Oonsie Biggs, Garry Peterson, 2 Stockholm Resilience Centre
Country Sweden
Abstract As pressures on the planet continue to grow, there is an increasing risk of regime shifts – large, nonlinear and potentially irreversible changes in social-ecological systems that can have major impacts on ecosystem services and human wellbeing. This poster introduces and summarizes current insights from the Regime Shifts Database (www.regimeshifts.org), a synthetic online database that aims to systematically compare the drivers and consequences of different regime shifts that have been documented in social-ecological systems around the world. We have developed a comparative framework that synthesizes information about a diverse set of regime shifts occurring at a variety of scales and system types based on the published literature. For each regime shift we record the potential regimes that exist; the feedbacks that maintain each regime; the multiple drivers of the regime shift; the impact of the regime shift on ecosystem services; and, the consequences of the regime shift for different sectors of society. In addition, we identify key leverage points that can be manipulated to enhance resilience or enable restoration or transformation towards more desirable regimes. We use simple systems models to synthesize this information. Comparing across 30 broad types regime shifts, we find that the ecosystems most affected by regime shifts are marine systems and freshwater lakes and rivers. Biodiversity is impacted by almost all regime shifts, and primary production and nutrient cycling are the most affected ecosystem processes. The most impacted ecosystem services include fisheries, wild plant and animal products, water purification, recreation and aesthetic values. The primary impacts on human well-being include livelihoods and economic activity, food and nutrition, and cultural, aesthetic and recreational values.

**Talk Title** **ASSESSING GOVERNANCE AND INSTITUTIONS FOR SUSTAINABLE TOURISM IN A MARINE PROTECTED AREA IN THE ANDAMAN SEA**
Theme How governance and institutions affect social-ecological systems, including capacity for learning and transformations.
Presenter Dr Thamasak Yeemin
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Abstract Relationship between tourism, livelihood and conservation is recognized as dynamic and complex system. Perceptions of the multiple stakeholders on environmental and ecological aspects are very important in driving the process of tourism in marine protected areas. Researchers, policy makers and managers have recognized that stakeholders' attitudes and behavior

towards the environment and conservation can lead to the success or failure of the sustainable tourism. The purpose of this study was to examine the environmental impacts of tourism at Ko Tachai, Mu Ko Similan National Park, in the Andaman Sea and to determine the factors that might influence stakeholders' intentions to engage in environmentally responsible behavior, based on field surveys and focus group interviews. Ko Tachai is among the most intensive tourism used in the Andaman Sea for recreational activities and the tourist numbers are over carrying capacity of the island. The coral reef degradation at Ko Tachai before the intensive tourism period caused by a few coral bleaching events, the 2004 Indian Ocean tsunamis, outbreaks of crown-of-thorns starfish and exposure during low tides of the shallow reefs. The intensive tourism activities have resulted in coral damages from boat anchors, boat groundings, tourist walking from coral reefs to the beach and sediment resuspension. The indirect impacts were sewages from accommodations on the island and tourist boats and large volumes of solid waste. Most coral fragments were the blue coral Heliopora coerulea and a branching coral Porites cylindrica at the shallow reef site. The marine national park, relevant government institutions, local government authorities, local communities, tourists and tourism enterprises have to work in collaboration to minimize the environmental impacts on the island. The perception of stakeholder groups on economic benefits, awareness, information access and sharing, governance structure, and resource use rights is urgently needed to be transformed for better environmental management. Improvement of ecological understanding, education, knowledge sharing, legislation and regulations, and collaborative planning and management is essential to enhance stakeholders' perceptions and assist in developing policies for sustainable tourism in the marine protected area. The marine national park policy needs to include interventions that inform the stakeholders concerning tourism and resource use activities and their environmental impacts on the island, especially coral reef, sandy beach and terrestrial ecosystems. Policy interventions are also required to encourage the stakeholders for participating in the marine national park planning and decision process, particularly the entrance fee issues, for conservation, sustainable tourism and environmental management.

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